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Harvard's American Journal of Education

## PREFATORY NOTE.

WITH this Number (for January, 1871), we resume the regular publication of the American Journal of Education, which has been somewhat intermitted, although not positively suspended, during our connection with the Department and Office of Education. We hope to receive sufficient encouragement to enable us to continue our articles, original and selected, on the existing condition and movements of Education in different countries, until we have given something like completeness to our survey of the past history and present condition of:—

### I. National Education in different countries in respect to:

1. Elementary Schools—Infant and Juvenile.
2. Secondary Schools—Public High Schools—Gymnasiums, &c.
3. Superior Schools—Universities—Colleges, &c.
4. Special and Class Instruction, viz.: (1) Theology; (2) Law; (3) Medicine and Surgery; (4) Teaching; (5) Agriculture, and Rural Economy generally; (6) Architecture and Construction of all kinds; (7) Chemical Technology; (8) Commerce and Trade generally; (9) Engineering, Civil, Mechanical and Marine; (10) Drawing, in its Ideal and Industrial applications; (11) Metallurgy and Mining; (12) Mechanics and Machinery; (13) Music—both Vocal and Instrumental; (14) Navigation—by steam and sail, on river and ocean; (15) Military and Naval Schools; (16) Public Service, the administration of Telegraphs, &c.; (17) Female Education—both general and special; (18) Exceptional Classes, such as Orphans, Deaf Mutes, Blind, &c.
5. Supplementary Schools and Agencies: (1) Evening Schools and Classes; (2) Libraries; (3) Lectures.
6. Societies for the Advancement of Art, Education, Literature and Science.
7. Architecture for Schools of every grade, and for all Educational purposes.
8. School Codes of different countries in reference to a discussion of the organization and administration of School Systems.
9. The Pedagogy of different Nations: (1) Germans; (2) Swiss; (3) French; (4) English; (5) American.
10. Educational Biography: (1) Teachers; (2) Promoters and Benefactors of Education.

II. The past history and present condition of Education as a Science and as an Art.

HENRY BARNARD.

HARTFORD, CONN., Jan. 15, 1871.



*an Technical Instruction - Special  
Report 1869 of V.  
National Series.*

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AMERICAN

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Journal of Education.

PUBLISHED QUARTERLY.

EDITED BY

HENRY BARNARD, LL. D.

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## PREFATORY NOTE.

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The following Report on Technical Schools, and Special Instruction generally in different countries, was printed in its present form by the subscriber in pursuance of a call, Jan. 19th, 1870, by the House of Representatives on the Commissioner of Education for information on the subject. It was not completed so as to be communicated to Congress at the time (March 15) his connection with the Office ceased; and has been brought to its present, still incomplete, condition, at the special request of members of the House Committee on Education and Labor, at whose instance the call was originally made. This portion (pages 33 to 786) is now published under the order of the House to print, in advance of the completion of the chapters relating to Great Britain and the United States, at the suggestion of the Commissioner of Education, to meet the calls on him for information respecting this class of institutions.

As originally planned, this Document would have constituted a portion (Part IV) of a comprehensive survey of National Education in different countries, which the undersigned had commenced in 1854, in view of a thorough discussion of the condition and improvement of Public Instruction in the United States. This Survey would embrace—

### PARTS I AND II. ELEMENTARY AND SECONDARY EDUCATION.

Volume I. The German States.

II. Switzerland, France, Belgium, Holland, Denmark, Norway and Sweden, Russia, Turkey, Greece, Italy, Spain, Portugal, Great Britain.

III. The American States—with a comparison of the systems and condition of Public Schools in the United States, with those of the more advanced states of Europe.

### PART III. UNIVERSITIES, COLLEGES, AND OTHER INSTITUTIONS OF SUPERIOR INSTRUCTION.

### PART IV. PROFESSIONAL, CLASS, AND SPECIAL INSTRUCTION.

(Schools of Theology, Law, Medicine, Teaching, Agriculture, Commerce, Engineering, Navigation, Mines, Technology, &c.)

### PART V. SUPPLEMENTARY INSTRUCTION.

(Libraries, Lectures, Evening Schools, &c.)

### PART VI. SOCIETIES, MUSEUMS, AND COLLECTIONS FOR THE PROMOTION OF EDUCATION, SCIENCE, LITERATURE, AND THE ARTS.

So far as the information relating to systems of elementary and secondary instruction was collected and prepared for publication in the Department or Office of Education, it will be communicated in a few days to the Secretary of the Interior, with a plan for its speedy completion and publication.

HENRY BARNARD.

WASHINGTON, June 29, 1870.



## INSTRUCTION IN SCIENCE AND ART.

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### INTRODUCTION.

A prominent defect, second only to the absence of all provision for the professional training of teachers, in our systems and institutions of public instruction in 1836, as compared with those of France, Switzerland, and the leading German States, as they were found after personal inquiry and observation, was the absence of special schools and classes for teaching drawing, geometry, physics, mechanics, chemistry, and the natural sciences generally, with special reference to the great national industries,—to commerce, locomotion, machinery, manufactures, mining, engineering and civil constructions of all kinds. The demand for engineers, and practical chemists and geologists, was very inadequately met by the Rensselaer School at Troy, by graduates (resigned, or detached from the public service) of the Military School at West Point, and by ingenious men, who educated themselves in practice (involving much cost and many failures), and from books, for their work.

Public attention in Connecticut was called to this omission in an address prepared in 1837, after my return from Europe, and delivered in 1838, and subsequently in connection with other topics of educational reform, in different parts of the country. Information in detail, on institutions referred to in this address, viz: the Polytechnic School of France, with the Special Schools of Applications in machinery, engineering and mines; the Conservatory of Arts and Manufactures, with its museums of machines and implements, and popular but systematic lectures; the Agricultural Course and industrial teaching of Fellenberg at Hofwyl; the Agricultural Institute in Wurtemberg; the Mining School in Saxony; the commercial and technical classes in the Institute at Vienna; the architectural lectures of the School of Arts in Berlin, and various incipient steps in the same direction in the Mechanic Institutes of England,—in a document first issued in 1839, and made part of my Annual Report as Secretary of the Board of Commissioners of Common Schools for Connecticut for 1839-40; re-issued with additions in 1847, as Commissioner of Public Schools in Rhode Island, and again in 1853-54 in the volume entitled National Education in Europe in the series of educational treatises issued as Superintendent of Common Schools in Connecticut.

In 1852, Samuel Colt of Hartford, the inventor and manufacturer of the Colt Revolving Fire-arm, contemplated the early establishment of



Evening Classes of elementary instruction for young persons in his employment whose school education had been neglected, and of instruction in drawing, chemistry and mechanics for such of his adult workmen as chose to avail themselves of it. In 1854, his plan was expanded into a regularly organized School of Mechanics and Engineering. As the resources from which he intended to endow it accumulated, he included courses of practical agriculture, horticulture and landscape gardening; and finally, on the breaking out of the war, he signified his purpose to alternate the practical work of the shop and the field with military drill. The institution thus projected and expanded was a comprehensive Polytechnic School—which would at once supply through its evening classes the deficient elementary schooling of his own workmen, meet the wants of technical instruction in any occupation in the community in which he lived, and offer a thorough scientific basis for the practical training of the agriculturist, the architect, the engineer, the machinist, the designer, the manufacturer, the miner and metallurgist, as well as of the candidate for any other of the leading industries of the country.

In the inception and development of his plan, he was pleased to consult me; and in 1854 signified his desire to name me in the instrument by which he should create and endow the trust, with a request that I would obtain full and reliable accounts of all establishments at home or abroad, which had any feature in common with the school which he contemplated, and which it was his purpose to endow by will beyond any literary institution in New England; and to be prepared to report a plan, when called on.

In pursuance of this request, and of studies already widely extended in the field of scientific and technical instruction, a large portion of the material for the chapters and special sections which compose this volume, were collected, and to some extent prepared for publication and printed in the American Journal of Education, at the time of Col. Colt's death in 1862, when it was found that his original purpose to endow by will such an institution had been revoked by a later codicil.

In 1863, at the request of Mrs. Colt, the work of collection and preparation was resumed, and a portion relating to Military Schools and Education was published in advance of the completion of the Report, which was intended to be a complete survey of Institutions for Special Instruction in the Sciences and Arts in different countries, to aid in the development of a Plan for a Polytechnic School, in the city of Hartford, Conn. Her object was simply to enable me to complete my survey of the whole field of Special Instruction; and was abandoned by her on the partial destruction of the Armory Buildings by fire in 1865. Since that date the work has been prosecuted to its present state of completion as rapidly as was consistent with other engagements.

HENRY BARNARD

## SECOND EDITION.

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THE circumstances under which the following Account of Systems, Institutions, and Statistics of Scientific Instruction applied to National Industries in different countries was originally prepared, and the manner in which the first incomplete edition was printed by the author in pursuance of the order of the House of Representatives (Jan. 19th, 1870), are set forth in the Prefatory Note, and Introduction. The Resolution of the House on the recommendation of the Committee on Education, the Secretary of the Interior, and my successor in the Office of Education, to print 5,000 copies for distribution by Members of Congress, did not reach the Senate in time to be acted on before the close of the Session. No subsequent action having been taken by the Senate, House, or Office of Education, to give circulation to a document which the author believes can be made of some service to the industrial development of the country, the following edition is issued for subscribers to the American Journal of Education, and through the ordinary channels of publication.

H. B.

HARTFORD, July, 1871.





SCIENTIFIC AND INDUSTRIAL EDUCATION: an Account of Systems, Institutions, and Courses of Instruction in the Principles of Science applied to the Arts of Peace and War in different Countries.

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## PROGRESSIVE DEVELOPMENT OF TECHNICAL INSTRUCTION.

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(1.) The adaptation of the studies of the School to at least a general preparation of the pupils for the life they were designed or desired to lead, has attracted the attention of teachers and educators in every age and nation, as will be seen in the historical development of public schools in the volume devoted to Elementary and Secondary Education.

(2.) The organization of studies and schools with special reference to certain professions which were found essential to the well-being of society—the theologians, doctors, lawyers, and the governing class generally, has been, in most countries, secured by the endowments, and other privileges of Universities.

(3.) The advancement of Science, and the Arts, and their cultivation, with special reference to the military service, the ornamentation of public buildings, and the gratification of the esthetic tastes of a few, have been secured by the creation of Academies and Special Schools in every civilized country.

An account of Universities, Military Schools, and Academies of Science and the Fine Arts, and their origin, growth, and present condition in different countries, will be given in another volume.

(4.) The popular exposition of the familiar phenomena of nature, and of the more obvious principles of science which underlie all local industries, dates back only to Comenius, and was brought into the range of the popular school by the labors of Hecker, Semler, Pestalozzi, Fellenberg, and particularly of the great Swiss educators. The establishment of Special Schools for thorough scientific training for civil as well as military purposes, belongs to the present century. The necessity for this training, and the subject and methods of this instruction, were pointed out by Bacon, and Milton, in the former century, but their suggestions made hardly a perceptible impression on the practices of their age. The Polytechnic School at Paris, was the earliest and best school of this class, and its remarkable success in the department of engineering and construction, as well as preparatory to the special work of war, led slowly to the establishment of similar institutions with a wider range of studies, in every nation of

Europe. The order of their institution was as follows: at Paris, in 1794; Prague, 1806; Vienna, 1815; Berlin, 1821; Carlsruhe, 1825; Munich, 1827; Dresden, 1828; Stuttgart, 1829; St. Petersburg, 1830; Hanover, 1831; Lisbon, 1851; Zurich, 1851.

(5.) The Real, and Trade Schools which grew out of the Real School of Hecker, and the Sunday and other Improvement Schools of Germany, recognized the necessity, and demonstrated the utility of special instruction in the principles, and, to some extent, the processes of the workshops; and schools and classes for this purpose now form part of the system of public instruction in every Continental State.

(6.) The success of the Mercantile Academy at Vienna in 1770, and Prague in 1765, has led to the establishment of public Commercial Schools in every great capital of Europe.

(7.) The Conservatory of Arts in Paris, the Museums of Industrial productions, and of raw material in the great centers of mechanical and manufacturing industry, have demonstrated their great usefulness to the skilled laborers of each country.

(8.) The International Expositions of 1851, 1856, 1861, and 1866, have brought the productions of the workshop of different countries into open competition, and the palm of superiority has been given to the workman, the shop, the country, in which the hand of the laborer had been guided by a cultivated taste and a scientifically trained intellect.

The results of these manifold experiences in the European States—in Schools, Museums, and Expositions, are somewhat elaborately presented in the following articles, which are made part of this Introduction, although they belong to a volume devoted to Special and Scientific Instruction in Great Britain.



# PLAN OF A TECHNICAL UNIVERSITY.

BY J. SCOTT RUSSELL.

---

Under the title of Systematic Technical Education for the English People, J. Scott Russell, a civil engineer of large experience, and wide observation of the results, both of deficient and thorough professional training in the designing, construction, and superintendence of great public works, and private manufacturing and mechanical establishments, has developed an elaborate scheme of special training for the different occupations demanded by the exigencies of modern society in England. These diverse trainings—the subjects and methods he has distributed into different schools, and then grouped into an institution which he calls the English Technical University. We have elsewhere copied his illustration of such a system, and of such institutions, drawn from the experience of Wurtemberg and Switzerland. We here bring together a condensed statement of the classes and schools for which he would provide.

*Classes for whom Systematic Education and Training is necessary.*

## CLASS I.

1. The Statesman. 2. The Soldier and Sailor. 3. The Theologian. 4. The Lawyer. 5. The Doctor.

(The first, third, fourth and fifth of these are provided by the Universities, and the second by the military schools.)

## CLASS II.

6. The Agriculturist. 7. The Miner. 8. The Metallurgist. 9. The Manufacturer. 10. The Civil Engineer. 11. The Mechanical Engineer. 12. The Machinist. 13. The Architect. 14. The Naval Architect. 15. The Merchant. 16. The Ship-owner. 17. The Merchant Sailor. 18. The Practical Chemist. 19. The Astronomer. 20. The Marine Engineer. 21. The Surveyor.

(Some of these are provided for by Government in the Royal School of Mines and of Naval Architecture, which might form portions of the future systematic course of education.)

## CLASS III.

22. The Professor of Pure Science. 23. The Professor of Literature. 24. The Professor of Fine Arts. 25. The Teacher or Schoolmaster. 26. The Political Economist.

(Some of these are imperfectly provided for in schools and universities.)

We omit Mr. Russell's classification of the Sciences and give his grouping of these Sciences with their practical applications, and work, into schools.

#### ENGLISH TECHNICAL UNIVERSITY.

When we have provided in our university fifty-six courses of study, covering the wide fields of education in matter and mind, it is quite obvious that we have merely embarrassed the youthful student by the number and variety of the subjects from which he has to select; and if we leave him free liberty of choice, it is evident that he will run the risk of much waste of energy and time. In order that our university may be of the greatest practical service to our student, we must aid him in his choice by presenting him with that selection of subjects which will most directly lead up to his aim in life, and most easily conduct him through the difficulties of learning to technical knowledge and technical skill. As we have in the former Chapter classed our professors according to the nature of the science they have to teach, so now we must class our students and their studies according to the nature of the aims in life which they have in view. This will group both teachers and taught into entirely new subdivisions.

It has already been agreed that we shall provide technical education for twenty-one or twenty-two professions, embracing all the modern professions, and excluding the three ancient ones,—theology, law, and medicine. And our first question is, whether for all these we must provide twenty-two separate and independent courses of study.

If these professional men were all to be educated in different schools—in buildings apart from one another—we might have to provide twenty-two courses of education; but as they are all meant to be taught in a single building, we shall be able to simplify the matter by means of systematic combination. Resuming here the list of professions for whom we are to provide education, we should have to form the following groups of studies, corresponding to the technical occupations of the students:—

#### SCHOOL OF MECHANICS.

*Pure Science.*—Higher Geometry; Higher Algebra; Higher Arithmetic; Higher Statics; Higher Dynamics; Higher Energetics; Higher Chemistry; Higher Metallurgy.

*Practical Applications.*—Descriptive Geometry; Constructive Geometry; Geometric Movements; Sources of Materials; Properties of Materials; Strength of Materials; Elements of Mechanics; Structural Mechanics; Machinery and Tools; Engines and Prime Movers; Economics of Work; Endurance of Machinery; Machine Shops and Buildings; Mechanical Manufactures; Political Economy; Workshop Economy; Principles of Design.

*Work.*—In the Drawing Office; In the Collection of Machines; In the Collection of Machine Materials; In the Collection of Raw Materials of Manufactures; In the Collection of Engines, &c.; In Mechanical Experiment; In the Factory; Round the Tour of Home Manufactories; In Foreign Travel.

#### THE SCHOOL OF CIVIL CONSTRUCTION.

##### THE ARCHITECTURAL.

*Pure Science.*—Highest Geometry; Laws of Number and Proportion; Statics; Psychology; Æsthetics; Physics; Chemistry; Animal Physiology; Botanic Organography; Geology; Art History.

*Practical Applications.*—Descriptive Geometry; Geometry of Vision; Constructive Geometry; Graphic Geometry and Surveying; History of Building Materials; Strengths of Materials; Chemistry of Building Materials; Geology of Stones and Cements; Mineralogy; Stability of Foundations; Stability of Structures; Theory of Arches and Roofs; Forms of Beauty; Forms of Strength; Proportions of Mass; Linear Decoration; Surface Decoration; Solid Decoration; Building Processes, Tools and Machinery; Building Economy; Building



Endurance; Domestic Health; Domestic Economy; Domestic Comfort; Laws of Sound and Hearing in Building; Laws of Ingress, Egress, and Seeing; Laws of Climate and Weather; On Use, Purpose, and Fitness; Principles of Design; Laws of Property and Buildings; Landscape Design.

*Work.*—In the Drawing Office; In School of Design; In Modeling School; In Mechanical Experiment; In the Museum of Ancient Models; In the Museum of Modern Architecture; In the Collection of Building Materials; In the Collection of Decorations and Art Workmanship; In an Office of Works; On the Works; On Travel at Home; On Foreign Travel.

#### ENGINEERING.

*Pure Science.*—Higher Geometry; Higher Algebra; Higher Arithmetic; Higher Statics; Higher Dynamics; Higher Energetics; Higher Hydrology; Higher Chemistry; Higher Geology; Higher Crystalloggy.

*Practical Applications.*—Engines and Prime Movers; Theory of Vehicles and Locomotive Machines; Theory of Ships and Steamboats; Chemistry of Building Materials; Geology of Stones and Cements; Mineralogy and Metallurgy; Stability of Foundations; Building Combinations of Materials; Sources of Materials of Construction; Theory of Bridges, Roofs, and Tunnels; Constructive Geometry; Graphic Geometry and Surveying; Descriptive Geometry; Perspective Geometry; Geometric Movements; Strengths of Materials; Elements of Mechanics; Machines and Tools; Theory of Rivers; Theory of Tides and Waves; Theory of Roads, Railroads, and Canals; Principles of Architectural Design; Principles of Metallurgy; Economics of Construction; Endurance of Structures, Engines, Machines, and Implements.

*Work.*—In the Drawing Office; In the Collection of Engineering Models; In the Collection of Building Materials; In the Collection of Machines; In the Laboratory of Strength of Materials; In the Chemical Laboratory; In Engineering Experiment; In the Factory; On the Works; In Foreign Travel.

#### THE SCHOOL OF MINES.

*Pure Science.*—Mathematics; Physics; Chemistry; Geology; Political Economy.

*Practical Applications.*—Descriptive Geometry; Trigonometrical Surveying; Mineralogical Drawing; Distribution of Minerals; Practical Mechanics; Elements of Machinery; Steam Engines and Boilers; Ventilation; Drawing; Physiology and Chemistry of Life.

*Work.*—In the Chemical Laboratory; In the Physical Laboratory; In the Drawing Office; In the Museum of Geology; In the Mine; In Foreign Mines.

#### THE METALLURGIST.

*Pure Science.*—Mathematics; Physics; Chemistry; Geology.

*Practical Applications.*—Smelting and Refining; Practical Mechanics; Strength of Materials; Descriptive Geometry; Mineralogical Drawing; Combustion and Ventilation; Elements of Machinery; Steam Engines and Boilers; Statics of Buildings; Nature of Machine Tools; Hydraulic Machinery; Electro-Magnetic Metallurgy.

*Work.*—In the Chemical Laboratory; In the Physical Laboratory; In the Drawing Office; In the Museum of Geology; In the Metal Manufactory; In Foreign Travel.

#### THE SCHOOL OF AGRICULTURE.

*Pure Science.*—Mathematics; Physics; Chemistry; Natural History; Geology.

*Applications of Science.*—Anatomy of Plants; Physiology of Plants; Anatomy of Animals; Physiology of Animals; Geology of Soils; Chemistry of Soils; Chemistry of Manures; Chemistry of Food; Veterinary Medicine and Surgery; Surveying, Leveling, Plan-drawing, and Draining; Practical Mechanics; Principles of Steam Engines; Agricultural Machinery and Implements; Nature and Influence of Climates; Buildings, Roads, Gates, and Fences; Training Fruit Trees, and Timber.

*Practical Work.*—In the Mechanical Workshop; In the Hospital for Ani-

mals; In the Farm; In Foreign Travel; In the Chemical Laboratory; In the Physical Laboratory; In the Drawing Office; In the Museum of Natural History; In the Museum of Geology.

#### THE GARDENER AND FORESTER.

Have an education of similar nature to the Agriculturist, with a specialty in each case. Both have, in addition, to study the principles of beauty in their applications to Landscape Decoration, and in their combinations with Architecture; both require a large course of instruction in the Theory of Climate, and in Physical Geography and Botanical Geography—both, therefore, must study Decorative Architecture. For the rest, the study of the same courses as the Agriculturist is necessary.

#### THE SCHOOL OF COMMERCE.

##### THE MERCHANT.

*Pure Science.*—Geography; Natural History; Ethnology; Political Economy; Doctrine of Probabilities; History; Languages; Ethics; Law.

*Practical Applications.*—Construction and Outfit of Ships; Docks and Warehouses; Physical Geography; Political Geography; Geography of Plants; Geography of Animals; Geography of Minerals; Weights and Measures of Nations; Moneys of Nations; Statistics and Wealth of Nations; Laws of Value; Laws of Insurance; Laws of Navigation; Principles of Exchange; Theories of Price; Interest and Banking; Laws of Commerce and Shipping.

*Work.*—In Natural History Collections; In Collection of Raw Materials; In Counting-house and Warehouse; In Foreign Travel.

##### THE MANUFACTURER.

*Pure Science.*—Mathematics; Physics; Chemistry; Natural History; Political Economy.

*Practical Applications.*—Geometrical Drawing; Decorative Drawing; Light and Shade; Light and Color; Principles of Beauty; Principles of Design; Chemistry of Color; Animal Substances; Vegetable Substances; Mineral Substances; Geography of Raw Materials; Mechanics of Raw Materials; Architecture of Manufactories; Architecture of Warehouses; Manufacturing Machinery; Commerce and Banking.

*Work.*—In Natural History Collections; In Collection of Raw Materials; In Collection of Machine Models; In Collection of Patterns of Manufactured Goods; In the Laboratory; In the Factory; In Foreign Travel.

##### THE SHIP OWNER.

*Pure Science.*—Elementary Geometry; Elementary Arithmetic; Elementary Hydrostatics; Elementary Hydrodynamics; Elementary Pneumatics; Elementary Chemistry; Elementary Geography; Elementary Natural History; Elementary Ethnology; Elementary Political Economy; Elementary Languages; Elementary Ethics; Elementary Law.

*Practical Applications.*—Descriptive Geometry; Strength and Values of Materials; Sources of Materials; Physical Geography; Weights and Measures of Nations; Laws of Nations (and Customs); Moneys of Nations; Laws of Commerce; Insurance (Principles of); Principles of Exchange; Docks, and Harbors, and Warehouses; Navigation; Seamanship; Ship Building; Marine Engine Building; Sail Making; Mast-making and Rigging; Equipment and Outfit; Lading and Storing; Manning and Clearing Out; Laws of Commerce and Shipping; Laws of Freight and Insurance; Laws of Measurement and Tonnage; Ship's Husbandry; Health, Food, and Safety; Wages and Disbursements; Merchandise and Exchange; Banking and Interest; Navigation Laws; Book-keeping; Stowage.

*Work.*—In the Drawing Office; In the Ship Model Room; In the Engine Model Room; In the Building Yard; In the Engine Factory; In the Harbor; In the Ship's Store Rooms; In the Warehouses; In the Docks; In the Repairing Yard; In Sail-maker's, Mast-maker's, Rigger's Yard.



## THE SCHOOL OF ASTRONOMY, NAVIGATION, AND SURVEYING.

## THE SAILOR.

*Pure Science.*—Elementary Geometry; Elementary Algebra; Elementary Arithmetic; Elementary Geography; Elementary Astronomy; Elementary Mechanics; Elementary Languages; Elementary Pneumatics; Elementary Hydraulics.

*Practical Applications.*—Drawing; Strength of Materials; Physical Geography; Commercial Geography; Nautical Astronomy; Chart-making; Marine Surveying; Submarine Surveying; Ship Building; Equipment of Ships and Outfit; Stowage and Tonnage; Mastng and Rigging; Laws of Tonnage; Customs and Clearance; Laws of Nations; Navigation Laws; Laws of Storms; Laws of Commerce; Laws of Freight and Insurance; Ship's Husbandry; Health, Food, and Safety; Book-keeping; Navigation; Seamanship; Harbors, Docks, and Slips; Weights, Measures, and Moneys; Steam-engines and Boilers; Artillery; Naval Tactics.

*Work.*—In the Drawing Office; In the Chart Room; In the Calculating Room; In the Ship Model Room; In the Engine Model Room; In the Building Yard; In the Engine Factory; In the Repairing Yard; In the Training Ship; In Ships at Sea; In Harbors; In Surveying Ships; In Ships of War.

## THE SCHOOL OF NAVAL ARCHITECTURE.

## THE NAVAL ARCHITECT.

*Pure Science.*—Higher Geometry; Higher Algebra; Higher Arithmetic; Higher Statics; Higher Hydrostatics; Higher Dynamics; Higher Hydrodynamics; Higher Chemistry; Higher Metallurgy; Higher Pneumatics.

*Practical Applications.*—Descriptive Geometry; Constructive Geometry; Sources of Materials; Properties of Materials; Strength of Materials; Elements of Mechanics; Structural Mechanics; Engines and Boilers; Propellers and Mechanism; Artillery and Protection; Metallurgy; Economics of Work; Laws of Commerce and Shipping; Freight and Insurance; Navigation; Seamanship; Lading and Ship's Husbandry; Naval Tactics and War; Health, Food, and Climate; Ship's Wages and Economics; Harbors and Docks; Equipment, Rigging, and Outfit; Storing and Lading; Measurement and Tonnage.

*Work.*—In the Drawing Office; In the Model Loft; On the Moulding Floor; In the Collection of Marine Engines; In the Collection of Materials; In the Collection of Ship Models; In the Experiments of Materials; In the Building Yard; At Sea; In the Engine Factory.

## THE MARINE ENGINEER.

This is a mixture of the Ship-builder and the Mechanical Engineer's courses of education, with experience superadded of building Marine Engines, erecting them on board ship, and managing them at sea.

We have now to consider how we shall group the students of these schools, that they may avail themselves simultaneously of such courses of education as are common to each group.

It is plain at first sight, that the civil engineer and the architect are allied professions; that the mechanical engineer and the machinist belong in one group; that the merchant and the ship-owner go together; that the manufacturer and the practical chemist have need of the same knowledge; that the miner and the metallurgist may be grouped together, as also the astronomer, the surveyor, and sailor; that the statesman, the political economist, and the man of literature, have many studies in common: and we shall thus be able to simplify much the courses of study each pupil may have to seek out and appropriate to himself.

I.—*The School of Mechanics.*—1. The Mechanical Engineer. 2. The Machinist. 3. The Marine Engineer.

II.—*The School of Civil Construction.*—1. The Civil Engineer. 2. The Architect. 3. The Naval Architect.

III.—*The School of Naval Architecture.*—1. The Naval Architect. 2. The Ship-owner. 3. The Marine Engineer. 4. The Sailor.

IV.—*The School of Chemistry.*—1. The Professor. 2. The Practical Chemist. 3. The Dyer. 4. The Mineralogist. 5. The Analyst. 6. The Chemical Manufacturer.

V.—*The School of Mines.*—1. The Miner. 2. The Metallurgist. 3. The Practical Chemist.

VI.—*The School of Commerce.*—1. The Merchant. 2. The Manufacturer. 3. The Political Economist. 4. The Ship-owner.

VII.—*The School of Agriculture.*—1. The Agriculturist. 2. The Gardener. 3. The Forester.

VIII.—*The School of Astronomy, Navigation, and Surveying.*—1. The Astronomer. 2. The Surveyor. 3. The Sailor.

IX.—*The School of Literature and Language.*—1. The Statesman. 2. The Political Economist. 3. The Teacher. 4. The Professor.

X.—*The School of Fine Arts.*—1. The Architect. 2. The Sculptor. 3. The Painter. 4. The Decorator. 5. The Designer.

XI.—*The School of Political Economy.*—1. The Statesman. 2. The Economist. 3. The Merchant. 4. The Manufacturer. 5. The Professor.

XII.—*The School of Metaphysics and Ethics.*—1. The Statesman. 2. The Professor. 3. The Moral Philosopher.

XIII.—*The School of Pedagogy.*—1. The Professor. 2. The Teacher. 3. The Schoolmaster.

XIV.—*The Preparatory and Supplementary School.*—A provisional arrangement for bringing up students who are insufficiently prepared for the University.

XV.—*The School of Mathematics.*—1. The Calculator. 2. The Actuary. 3. The Statistician. 4. The Surveyor. 5. The Astronomer. 6. The Professor.

XVI.—*The School of Science and Philosophy.*—This is a school for the training of philosophers, men of science, and men of leisure, who may not propose to become members of professions, but who desire to cultivate the sciences and the philosophies for purposes of personal improvement, and hope to apply their knowledge to the advancement of human society.

Each School must have its Museum of material, apparatus, and practical machinery, and each Science its technical books, and means of special illustration or experiment.

#### *Local Technical Colleges.*

Subordinate to this metropolitan university, local technical colleges should be placed in every great centre of local industry. The subjects taught would be nearly the same as in the university, only the theoretical part would not be carried to the same heights of science, and the technical part would be more fully carried out into the technical details of the industries of the neighborhood. Specially attached also to each of them would be an extensive collection of models, examples, materials belonging to the local industries, and a free technical library, with a comfortable reading room.

#### *Country Trade Schools.*

The lower class of institutions would be those which either form preparatory schools for the technical colleges, or finishing technical schools for those who can go no further; and these should pervade not only the whole country, but the large towns and the metropolis, there being one such institution for every 20,000 inhabitants in town districts, and for every 10,000 in country districts; and either in the same building or in a different one there should be technical schools in the evening, as complete in their course of instruction for the working men, as in the morning for the youth of the district; and to these schools should be attached a library, museum, and reading-room, similar to that of the colleges, only more elementary, and on a smaller scale. It is these local night schools and libraries for the working men that ought to fulfill the duties in which our mechanics' institutions have so wofully failed, and it may in some cases be convenient that the government should make use of the building and organization of these mechanics' institutes for these technical evening schools.



## INTERNATIONAL EXHIBITIONS AND TECHNICAL INSTRUCTION.

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### HISTORICAL.

THE most important event in the history of governmental interposition in scientific and technical instruction in Great Britain was the Universal Exposition of the Industries of Nations held in London in 1851—the first of that series of sublime lessons, read of all men, of the dignity and value of human labor and artistic skill, when directed by science to a knowledge and to the observance of the laws of nature, which has already modified, not only in Great Britain, but in all civilized nations, systems and institutions of industrial training. The approach to this first great demonstration of the existing condition of the industry and products of the world—to this series of competitive trials of intelligence and skill between workmen of the same and different nations, trained in different ways in the use of the same material, for the same purposes of utility and ornamentation—was gradual. In all civilized countries, exhibitions of a local or provincial character, and in some cases of national scope, had been held within the last half century. In England, the Society of Arts, as early as 1756, had offered prizes for specimens of tapestry, carpets and porcelain, and in 1761, of pictures and engravings, displayed in rooms of the Society at London; but it was not till 1828 that a national exhibition of the products of the workshops, factories and studios of England, of a varied and general character, took place in London, under the name of the Royal Repository. This was followed, in 1837, 1839, and 1849, at Manchester, Leeds, and Birmingham.

In France the first systematic and successful Industrial Exhibition of national importance was held in 1798, on the suggestion, and under the management of the Marquis d'Aveze, commissioner of the national manufactories of Sèvres and the Gobelins. The second took place in 1801, and the third in 1802, under the active lead of the First Consul (*Napoleon*), assisted by a commission of the most scientific men of France, who visited the most important factories, workshops, and ateliers of France, to explain the individual and national advantages of such an exhibition of the products of every department of labor and skill. That of 1801 was held in the quadrangle of the Louvre, and one of the bronze medals was awarded to Jacquard for his loom. To give stability and provide the agency of similar exhibitions, a Society for the Encouragement of the Industrial Arts and Manufactures of France was instituted in 1802, and under its auspices, aided by the government, numerous National Fairs have been held—each with a larger number of exhibitors, and with more varied specimens of scientific invention and artistic skill—especially in the direction of common wants. The Exhibition of 1849 is remarkable for the proposition

of M. Buffet, the Minister of Agriculture and Commerce, to all the Chambers of Commerce, to include specimens of the industrial productions of other nations in the competitions for honorable mention and premiums. But the proposition did not meet with general favor, and its consideration was dropped. The various French Expositions had been much frequented by the manufacturers and designers of other countries, and numerous illustrations of the finest articles in the domain of Art had been published—especially of those of 1845, and 1849—in other countries; the broad international advantages of such displays of the perfected specimens of artistic and trained labor impressed many minds in different countries, but nowhere with such immediate practical results as in England. It only needed the right word from the voice of authority to bring this feeling into action; and that word was uttered by his Royal Highness, Prince Albert of England, to the Society of Arts, Manufactures, and Commerce, of which he was President:—"Now is the time to prepare for a Great Exhibition—an Exhibition worthy of the greatness of this country, not merely national in its scope and benefits, but comprehensive of the whole world, and I offer myself to the public as their leader, if they are willing to assist in the undertaking." The offer was accepted—the Society, the press, capitalists, manufacturers, artists, artisans, and finally the government, enlisted; and in the summer of 1851, in the Crystal Palace in Hyde Park, in the presence of 100,000 people of every nation, the Great International Exhibition of the products of every clime, and the fabrics of the workshops of every tribe, was inaugurated. The Exhibition—the first great competitive trial of nations in the peaceful field of industry—was a complete success—a sublime monument of the dignity and value of labor, when directed by intelligence and taste, to minister to the necessities and rational pleasures of mankind.

#### RESULTS.

The benefits resulting to Great Britain, and sooner or later in the influence of this and similar exhibitions, to all countries, from the Great Industrial Exposition of 1851, can not be over-estimated, although it may be difficult to present them in a condensed statement. We shall notice only a few, with special reference to technical instruction—the formal training of workingmen of all grades in knowledge, taste and skill in their several occupations, through familiarity with the best specimens of material, implements, machinery, and work, collected in museums or exhibitions, and opportunities of study and practice in schools organized and conducted with special reference to imparting such knowledge, taste, and skill.

1. Every person, who made even a brief visit to the Exhibition, had a clearer conception of a finished specimen of manufacture or handicraft, in the line of his own wants, than he had before, and thus a demand for a better style of workmanship was created.

2. Every artist, manufacturer, foreman, or operative who visited the Exhibition, and especially those who studied the department with which he was most familiar, or the most interested, had in his mind a higher standard of possible attainment than most of them had before reached. Efforts at improvement in design, and in detail, were at once made, and the means for further improvement were demanded, and, to some extent, furnished.

3. The attention of capitalists, public-spirited citizens and statesmen was



forcibly arrested to the necessity of providing at once better elementary training for all classes, and especially for those who have to live by their labor; and at the same time, securing to designers, engineers, foremen and superintendents generally of large works, better artistic and scientific training. The immediate results of this attention, and agitation, were more liberal appropriations for primary schools, and for schools of science and art, a general discussion of the whole subject of National Education, and the final passage in 1870 of an act, establishing a system of elementary schools for England, as well as the earlier creation of the Government Department of Science and Art, which is rapidly changing the whole aspect of scientific and technical instruction in Great Britain, and influencing its development in every civilized country. The Museum of Industrial Art at South Kensington, created since 1852, with its affiliated schools and museums, central and provincial, is now the model for imitation for Europe and America.

4. The perpetuation of the unique structure designed specially for the Exhibition, in the Crystal Palace at Sydenham, and its equipment, and the embellishment of the grounds for the avowed purposes of public utility and recreation, "in the direction of science and art," at a cost of over £1,500,000—has already accomplished its object with more than 4,000,000 visitors who have been attracted to the spot up to 1869.

5. The permanent organization and continued activity of the original Commission, composed of some of the most eminent men (in science, letters, arts and affairs) in the kingdom, through whose wise management this unprecedented enterprise was a pecuniary success—is another result, which is perpetuating the influence of the Great Exhibition in many directions:—

*First*—In securing the possible union of many institutions of Science and Art, on almost the only central spot within the vast circumference of the metropolis which could be secured for the purpose. The purchase of the Gore Estate in South Kensington, having with subsequent exchanges and purchases an area of 100 acres, accessible by railways and other cheap public conveyances, and connected with public parks and grounds, already highly improved, to an extent of 640 acres—out of the surplus income of the Exhibition (150,000*l.*) and a special grant of a like sum by Parliament.

*Second*—The subsequent erection on this estate of buildings devoted to Art and Science at a cost of over 1,000,000*l.*, and the gathering within them of museums and collections (hardly yet begun) which the like sum could not even now purchase.

*Third*—The erection of an appropriate hall for annual exhibitions of industrial productions, and other purposes, at an expense of near 300,000*l.*

The purchase and improvement of this estate for the promotion of scientific and artistic knowledge, as applicable to productive industry, would not have been possible but for the Great International Exhibition of 1851. No fitter memorial of the first suggester of this enterprise—the good Prince Albert, "to whose far-seeing and comprehensive philanthropy its first conception was due, and to whose clear judgment and untiring exertions in directing its execution, the world is indebted for its unprecedented success,"—could be devised than this estate thus improved. No monument at once so attractive for all classes in the kingdom, or so full of instruction and inspiration of the noblest kind for all time, in every department of industrial activity, both that which ministers to



the necessities and comforts of life, and that which labors to realize in form and color, the loftiest ideal of the artist and poet,—could be erected to perpetuate the memory of this great event in the history of national industries, than the grounds and structures devoted to Science and Art in South Kensington, secured by the wise management of the Commissioners of the Exhibition of 1851.

#### ALBERT HALL OF ARTS AND SCIENCES.

The first stone of a solid, majestic, and ornamental structure was laid by her Majesty the Queen on the 20th of May, 1867, on the site north of the Gardens of the Royal Horticultural Society at South Kensington—to be known as the ALBERT HALL OF ARTS AND SCIENCES, and to be used for the promotion of scientific and artistic knowledge as applicable to productive industry. The Royal Commissioners gave a site valued at 60,000*l.*, and advanced the sum of 50,000*l.* towards the cost of the building, which has been contracted for within the original estimate of 200,000*l.* The hall will accommodate 9,000 persons, and will be used only in the interests of Science and Art—the first occasion being the inauguration of the First Permanent Exhibition of Industrial Art in the spring of 1871.

The objects for which the Hall will be available, as enumerated in the Charter of Incorporation, are:—

(a.) Congresses, both national and international, for the purposes of Science and Art.

(b.) Performances of Music, including performances on the organ.

(c.) The distribution of prizes by public bodies and societies.

(d.) Conversaciones of societies established for the promotion of Science and Art.

(e.) Agricultural, horticultural, and the like exhibitions.

(f.) National and international exhibitions of works of art and industry, including industrial exhibitions by the artizan classes.

#### ANNUAL INTERNATIONAL EXHIBITIONS.

The Commissioners of the International Exhibition of 1851 have arranged for a series of Annual International Exhibitions of Select Works of Fine and Industrial Art and Scientific Invention—arranged in classes and not according to nations. The first of the series will be opened, Monday, May 1, 1871, in permanent buildings adjoining the arcades of the Royal Horticultural Gardens, and closed Saturday, September 30, 1871. The objects in the first exhibition will consist of the following classes:—

I. *Fine Arts Applied or not Applied to Works of Utility*—embracing (1.) Painting of all kinds. (2.) Sculpture, modeling, carving, and chasing. (3.) Engraving. (4.) Architecture. (5.) Tapestries, carpets, embroideries. (9.) Designs for decorations, manufactures. (7.) Copies of mosaics, enamels, &c.

II. *Scientific Inventions and New Discoveries* of all kinds.

III. *Manufactures*.—(a.) Pottery of all kinds. (b.) Woolen and worsted fabrics. (c.) Educational.—1. School buildings, fitting, and furniture. 2. Books, maps, globes, &c. 3. Appliances for physical training, including toys and games. 4. Specimens and illustrations of teaching fine art, natural history, and physical science.

IV. *Horticulture*.—International exhibitions of new and rare plants, fruits, vegetables, flowers, &c., will be held by the Royal Horticultural Society, in conjunction with the above exhibition.

One-third portion of the whole available space will be assigned absolutely to foreign exhibitors.



## SPECIAL INSTRUCTION IN AUSTRIA.

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### INTRODUCTION.

SINCE the cession of the Lombardo-Venetian provinces to Italy, the Austrian monarchy has an area of 227,234 square miles, and a population in 1864 of 34,432,890, distributed throughout—

I. *The Empire of Austria*, comprising the provinces of Lower Austria, Upper Austria, Salzburg, Styria, Carinthia, Carniola, Illyria, Tyrol and Vorarlberg, Bohemia, Moravia, Silesia, Galicia, Bukovina, Dalmatia; and

II. *The Kingdom of Hungary*, comprising the provinces of Hungary, Croatia, Slavonia, Transylvania, and the Military Frontier. Each of the two great divisions has its own ministry, parliament, and entirely separate administration, and every province has its own provincial diet.

Austria [Empire] has, on an area of 124,116 square miles, a population of 20,602,736, and the Kingdom of Hungary, on an area of 103,118, a population of 13,830,154. The national industries are as varied as the climate and soil, and have called into existence a large number of special schools.

The total expenditure in 1864 was 508,781,793 florins, of which sum 2,951,523 florins were expended for public instruction of all kinds, viz., 139,828 fl. in Hungary, and 2,580,670 fl. in Austria. The institutions of public instruction, both in Austria proper and in Hungary, are under a separate and special minister, except such as are specially connected with the administration of other departments, such as those of war, finance, &c.

The system of public instruction is comprehensive,\* and in every department at the present time there is progress. The recent school code (1869) will compare favorably with the most advanced legislation of any country in respect to elementary instruction.

The following statistics are gathered from the latest official documents.

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\* For a historical development of public instruction in Austria, see American Journal of Education, vol. xvi. p. 1—32, 609; xvii. p. 129. Special Report on *National Education*: PART I. Germany—*Austria*.



PUBLIC INSTRUCTION IN AUSTRIA.

1. ELEMENTARY SCHOOLS IN 1864.

	SCHOOLS.	TEACHERS.			PUPILS.		
		Male.	Female.	Total.	Boys.	Girls.	Total.
Austria,.....	14,587	24,079	621	24,700	877,181	779,758	1,656,939
Hungary,.....	14,642	31,078	2,446	33,524	610,984	478,494	1,089,478
Empire, .....	29,229	55,157	3,067	58,224	1,488,165	1,258,252	2,746,417

Connected with these schools, and taught by the same teachers, are 1,472 Female Industrial schools; 382 Apprentice schools; 15,752 Sunday Repetition schools; 2,777 schools for instruction in fruit culture 352 for bee culture 169 for silkworm culture.

2. SECONDARY SCHOOLS.

	GYMNASIA.			REAL-GYMNASIA.			REAL-SCHOOLS.			TOTAL SECONDARY SCHOOLS.		
	Num-ber.	Scholars.	Teach-ers.	Num-ber.	Scholars.	Teach-ers.	Num-ber.	Scholars.	Teach-ers.	Number.	Scholars.	Teachers.
Austria,.....	97	32,076	1,532	6	1,081	64	48	10,547	597	151	43,704	2,193
Hungary,.....	132	26,722	1,335	1	57	9	23	4,094	315	156	30,873	1,659
Empire, .....	229	58,798	2,867	7	1,138	73	71	14,641	912	307	74,577	3,852

3. SUPERIOR SCHOOLS.

In Austria there are 7 universities, viz., 5 with four faculties [theology, law, medicine, philosophy] each: Vienna, Gratz, Prague, Cracow, and Pesth; and 2 universities with three faculties [theology, law, philosophy] each, viz., Innsbruck and Lemberg—with a total of 9,198 students and 650 professors.

4. SPECIAL AND PROFESSIONAL SCHOOLS.

Character of Institution.	AUSTRIA.			HUNGARY.		
	Number.	Teachers.	Students.	Number.	Teachers.	Students.
Theological Seminaries—Roman Catholic,.....	43	212	1,653	25	127	873
“ “ Unitarian,.....	—	—	—	1	2	17
“ “ Greek Catholic,.....	1	3	23	5	27	225
“ “ Armenian,.....	1	9	23	—	—	—
“ “ Greek Oriental,.....	4	18	176	4	14	211
“ “ Protestant,.....	1	6	60	5	40	133
Schools of Surgery,.....	4	41	517	2	28	236
Schools of Midwifery,.....	14	26	768	2	2	212
Agricultural Academies,.....	—	—	—	1	9	150
“ Schools,.....	13	90	580	3	18	162
Horticultural Schools,.....	2	5	69	—	—	—
Schools of Vine-culture,.....	3	10	56	1	5	23
Schools of Silkworm culture,.....	1	1	45	—	—	—
Forest Academies,.....	1	4	69	1	18	213
Forestry Schools,.....	4	30	134	—	—	—
Mining Academies,.....	2	18	151	—	—	—
Mining Schools,.....	2	7	77	3	7	63
Nautical Academies,.....	1	18	112	—	—	—
Nautical Schools,.....	5	11	78	2	13	50
Polytechnic Institutes,.....	2	74	969	1	28	270
Polytechnic Institutes with commercial course,..	4	98	1,672	—	—	—
Commercial Academies,.....	3	60	909	1	19	240
Veterinary Schools,.....	2	6	32	—	—	—
Military Academies,.....	3	112	619	—	—	—
Special Military Schools,.....	8	72	702	—	—	—
Cadet Schools,.....	2	30	358	2	30	338
School Companies,.....	8	74	891	—	—	—
Schools for Soldiers' Children,.....	8	56	1,046	4	37	697
Schools of Gymnastics,.....	3	9	731	—	—	—
Academies of the Fine Arts,.....	1	22	218	—	—	—
Drawing Schools,.....	19	30	1,480	—	—	—
Music Schools,.....	84	184	3,649	—	—	—
Institutes for Deaf and Dumb,.....	14	70	711	—	—	—
Institutes for Blind,.....	5	41	207	—	—	—
Teachers' Seminaries,.....	80	300	2,209	35	200	957
Academies of Oriental Languages,.....	1	8	8	—	—	—
Law Schools,.....	—	—	—	11	720	1,303



## SYSTEM AND INSTITUTIONS OF SPECIAL INSTRUCTION.

The system of special technical instruction in Austria includes in its early stages, or at least recognizes, the future occupation of the pupils, in the primary schools of every grade, and in one of the grades of schools usually classed as secondary.

## INDUSTRIAL INSTRUCTION IN COMMON SCHOOLS.

The first notice of the industrial element in Austrian schools, we find in the normal, or model school of Kindermann, at Kaplitz in Bohemia. In 1773, he taught and demonstrated to his pupil-teachers, and the country school-masters, how to occupy a portion of their own time and that of their older pupils, in and out of school hours, in such in-door industries as knitting, sewing, wool carding, and spinning, and out-door work as kitchen gardening, culture of trees, and raising silkworms. "The advantages of these occupations are great and important. They protect against vice and crime, and promote the welfare of human society." Under his lead, in the first year of this century, 2,644 public schools were in operation in Bohemia, 54 of which were burgher-schools, in which the aim was "to give the future citizen an instruction adapted to his special occupation."

Instruction in needle-work and like feminine employments, is now usual in the female schools, and the girls' classes in mixed schools, and receives special attention in the industrial schools of the religious corporations and ladies' societies. Instruction in the care of mulberry trees, grape vines, bees, and orchards is given in the normal schools, and by their pupils to the older boys in a large number of districts.

## SUNDAY AND OTHER IMPROVEMENT SCHOOLS.

In close connection with the common school, and through the same agencies, the "further instruction" of boys after leaving school and entering into apprenticeship, is carried on with the assistance and special inspection of Chambers of Commerce, and local associations of tradesmen. The instruction is given on Sunday and holidays (except the high feasts), and in the morning and evening of other days. It is not confined to a review of the rudimentary studies, but is extended to higher arithmetical calculations, book-keeping, bank dealings, business correspondence and forms, natural history, and particularly to drawing. A record of attendance is kept, and delinquent parents and employers are fined, and proprietors of large establishments are subject to arrest and imprisonment for persistent neglect in respect to their apprentices and other juvenile operatives.

## BURGHER SCHOOLS.

The burgher school, which belongs to the primary system, originally intended to prepare pupils for the occupation of tradesmen and mechanics by a better general education, has become a subordinate real school, the students generally entering the higher real school after finishing the course.

There are thirty hours of instruction per week, embracing religion, composition, German, arithmetic, geography, natural philosophy, chemistry, geometry, architecture, geometrical and architectural drawing, and a little historical detail. French, Italian, English, music, and gymnastics, are optional. The tuition fees are small, and are remitted if the pupil is poor and has conducted himself well.

In 1865, there were 117, of which but seven gave a three years' course, the rest only two years; instruction being given by the director and catechist of the primary high school, with 365 additional teachers. The instruction in arithmetic, German composition, geography, natural philosophy, chemistry and drawing, is given in the higher classes in special reference to a commercial and mechanical career.

## REAL SCHOOLS.

The object of the real school is to give to its pupils a general education, the dead languages being excepted, and "to fit them to enter the technical schools, or to pursue industrial careers."

They have been gradually developing since 1751, but do not appear as distinct organizations before 1851. In 1863, there were forty of them in the Austrian empire, of which there are sixteen "lower real schools," with a course of only three years, and twenty-four "complete real schools," which carry their students through six years, thus adding three years to the course at the lower real school. There is, in three of the lower schools, an additional class, in which instruction is given in technology, commodities raw and manufactured, commercial transactions, and particularly in drawing.

The lower real schools turn out pupils well prepared, theoretically, to become master workmen and overseers; those called complete, prepare students who finish the course, to enter the technical schools.

The course of study varies somewhat in different places. The obligatory studies are, German (or the language of the province), one modern language—French, Italian, or English, geography, history, arithmetic, geometry, physics, chemistry, commercial law, natural history, drawing, modeling (in the highest class), ornamental penmanship, architecture, and mechanics. Latin has been added in some of the lowest classes. The modern languages, singing, gym-



nastics, and stenography are optional. Of the above studies, elementary mathematics, machinery, and the modern tongues are taught only in the higher classes, in which calligraphy is no longer obligatory.

The complete schools have twelve professors, the lower schools seven. Those applying for these positions must pass an examination as to their scientific attainments, and undergo a year's probation in a public real school, before receiving the appointment. At the head of the corps of teachers is a director, who, with the council of teachers, governs the school, subject to the supervision of the general councilor of schools.

The fees paid by pupils vary from eight to twenty florins annually, besides a fee of about two florins at admission. All the fees may be remitted to poor pupils conducting themselves well.

The yearly expenses of a lower school amount to from 8,000 to 11,000 florins; of a higher school, to from 15,000 to 20,000. They are either imperial royal, in which case the general government supports them, or communal, supported by the towns. Besides these, two are endowed, and one is private, assimilated.

#### SPECIAL TECHNICAL SCHOOLS.

Technical instruction in Austria is of very long standing, and at the beginning of this century three important technical schools were in operation, and others were instituted long before the neighboring German States had moved in this direction.

In 1717, a professorship for military and civil engineering was established at Prague, which gradually extended itself into a school of engineering, and became in 1806 the first independent polytechnic school in Austria. It has undergone many changes, and in 1865 was organized on the plan of special schools, uniting on a general preparatory course.

In 1745, the Empress Maria Theresa organized in Vienna the first university lectures on experimental physics, and in 1757, on mechanics, and in 1763, permitted instruction in book-keeping to be given at the Piarist schools, and at the same time established several schools for apprentices. In 1770, a Real and Mercantile Academy was established in Vienna, which became in 1816 the polytechnic institute.

In the year 1763, the first lectures were held on mining at Schemnitz, and in 1770, the school in Prague being given up, the Mining Academy was founded there. Its fame was soon so great that Fourcroy, in his brilliant speech made in the French National Assembly, 1794, as an incentive to the erection of the polytechnic school in Paris, referred to this school as a well known model for imitation.



In 1811, the Johanneum in Gratz was founded by the Archduke John, as a museum and institution for natural sciences, and was afterwards changed, little by little, into a polytechnic institute.

In 1843, the Real and Mercantile School in Lemberg was changed, by the addition of several courses, into a technical institute, and in 1846, a technical school was founded at Cracow, and in 1849, another at Brünn.

In 1856, the Industrial School at Pesth was removed to Ofen, and received there the organization of a Polytechnic Institute, so that in 1859 there were seven technical institutions of the first class, with 157 professors, and 3,531 students, distributed as follows :

Location.	Professors.	Students.
Vienna Polytechnic Institute, - - -	54	1963
Prague " " - - -	25	617
Brünn " " - - -	13	196
Lemberg " " - - -	11	229
Cracow " " - - -	14	171
Ofen " " - - -	24	201
Gratz " " - - -	16	154

The plan of instruction embraced both technical and commercial studies, except at Prague and Ofen, where technical instruction only was given. In Vienna there was a preparatory school, and a school of industrial drawing, which accounts for the larger number of pupils ; Cracow has a school of fine arts, and of music, and Ofen a preparatory school.

In 1850, a reorganization of the technical institutions was proposed, by which they should be raised into institutes of the highest class, with a system of special schools, as had been already instituted at Carlsruhe. After many years of agitation, in which the professors, and large manufacturers, and capitalists, as well as statesmen, took part, a new plan of studies was introduced at Prague in 1864-65 ; at Gratz in 1865-66, and in Vienna in 1866-67. At Vienna and Prague there are four schools: 1. Civil Engineering; 2. Architecture; 3. Machinery; 4. Technical Chemistry. At Gratz, agriculture and forest economy, and surveying take the place of architecture. At Gratz and Vienna there are two general classes, which precede the special courses. At Brünn by decree of 1866, two regular courses for construction of machinery and technical chemistry, and three special courses, one for commerce, and one for master mechanics and builders, and a third for miners, have been established.

Besides the Technical schools, there has grown up in Austria special schools of Agriculture, Commerce, Navigation, &c., of which a rapid survey will now be given, drawn from original documents, and the reports of the French and English commissioners.

## II. TECHNICAL INSTITUTIONS AND CLASSES.

We will now give from official documents, or from the Reports of the English and French Commissions, drawn up from the same or similar documents, with the advantage of recent personal visits to the institutions described, a brief notice of a few specimens of each grade of scientific and technical instruction.

### APPRENTICE AND WORKMEN'S SCHOOLS.

The schools, which are known in Prussia and great part of Germany by the name of Improvement Schools (*Fortbildungsschulen*) are in Austria called Trade Schools (*Gewerbeschulen*), or industrial schools. The confusion which these different significations of names may cause, ceases when we examine the object, the conditions, and the nature of the instruction given in these establishments. Their creation in Austria, and in Vienna especially, dates only from the year 1857, when the Industrial Society was formed, with the approbation of the Government and the assistance of the municipality.

The members of this Society imposed on themselves, in principle, the obligation of sending their apprentices, during the last year at least of their time, to follow the classes, which, under the title of *Gewerbeschulen*, should be opened in the *Real* or practical schools of the State or those of the town, and also to pay a subscription in proportion to the importance of their establishments, even when they had no apprentices. This voluntary contribution is fixed at four kreutzers per florin (or one-fifteenth) of the taxes paid. On the other hand, it was decided that the apprentices should attend these classes during their last year, or in default should not be regarded as having finished their apprenticeship.

The teaching in each of these schools is under the supervision of the director, and is given by the professors of the practical school to which it is attached. The latter receive an addition to their salary in proportion to the number of hours' lessons; if one of the professors be unable to undertake this additional work, the director appoints another person in his stead.

In 1861, owing to the efforts made by the Chambers of Commerce and the manufacturers, there already existed in the suburbs of Vienna five of these schools annexed to the practical schools of Gumpendorf, Wieden, Landstrasse, Jägerzeile, and Schottenfeld, as well as a school of weaving (*Weberschule*) at Gumpendorf, and a practical school of building. They have the use of the premises, collections, and teaching appliances of the practical schools without any expense; but the models of a more technical kind required are purchased with their own funds.

#### I. TRADE SCHOOLS FOR APPRENTICES IN VIENNA.

There are six trade or industrial schools in Vienna attached to the *Real* Gymnasium or Practical Schools, having a general resemblance, but with special instruction adapted to the vocation of the pupils who are apprentices and journeymen from the vicinity of the school.

The instruction is divided into an elementary section having two classes, and several sections relating to different industrial specialties. In the elementary section theoretical instruction is given and the pupils are practised in the art of drawing, with especial adaptation to the future career of each. In the special sections, the knowledge acquired is applied to the branches of industry chosen



by the pupil. The organization of the specialties must be adapted, in every district, to the requirements of the local industries. The specialties of the Gumpendorf school are therefore principally those necessary for weavers, workers in silk, ribbons, trimmings, dyeing, &c. The school of Wieden has specialties connected with machinery, and such trades as brass-turners, joiners, bookbinders, workers in copper and bronze, founders, &c. In the Jägerzeile school the courses bear chiefly on the building trades.

The number of hours is nine and a half during the week, partly after half-past six in the evening, and partly on Sundays in the forenoon. No class must exceed 50 pupils; if there are more, it must be divided into two. In the first class of the elementary section the time allotted to the different lessons is as follows: Religion, 30 minutes; German language, 2 hours; arithmetic, 2 hours; calligraphy, 1 hour; drawing, 4 hours; total,  $9\frac{1}{2}$  hours per week.

The following is the allotment of time in the second class of the elementary section: Religion, half hour; German, exercises in style and commercial correspondence, 1 hour; arithmetic and mensuration, 1 hour; elements of physics, 2 hours; geography, 1 hour; drawing, geometrical and free-hand, projections, drawing of figures and ornament, and modeling, 4 hours; total,  $9\frac{1}{2}$  hours per week.

By this arrangement a single pupil attends, including the three kinds of drawing,  $17\frac{1}{2}$  hours instruction per week at most.

In the special sections the lessons are thus distributed: Industrial drawing, 4 hours; architectural drawing, estimates, 4 hours; drawing of machines, mechanics, study of machines, 4 hours; modeling, and drawing from the round, 4 hours; general chemistry, 1 hour; study of raw materials, 1 hour; commercial book-keeping, &c., 1 hour; applied mechanics, 1 hour; applied chemistry, 1 hour; total, 21 hours per week.

In the two elementary sections, the instruction is compulsory for all the courses. In the special sections, on the contrary, the choice of courses is left to the pupils.

The school year commences on the 1st of October and ends on the 31st of July. At the end of the year, the pupils receive certificates giving an account of their behavior, application, and progress in the different branches. The most proficient pupils receive as prizes silver or bronze medals, or honorable mentions.

The director of the practical school, to which the school for apprentices is annexed, is the principal manager. He, however, shares this authority with a delegate of the Industrial Society. They both endeavor to introduce into the teaching all the improvements required by the necessities of the local industries as indicated by the presidents of the industrial associations which patronize the schools. The instruction, as already stated, is given by the professors of the corresponding courses of the practical school (*Realschule*,) provided that the professors have sufficient time at their disposal and are satisfied with the payment offered. When any professor declines to undertake a course in the apprentice school, the director has to look for a teacher elsewhere. For the technical instruction, the director may, with the authorization of the municipal authority, admit as professors either manufacturers or foremen, who, in everything connected with the teaching, will be under his orders. For the purchase of apparatus and all things necessary for consumption and use, there is a yearly budget placed at the disposal of the director in concert with the professor of the specialty concerned.

The general management of the trade schools of Vienna is entrusted to a council composed of the presidents and vice-presidents of the chambers of com-



merce and manufactures, of the representatives of the province and city of Vienna, of the president of the committee of each school, and, lastly, of members of the chambers of commerce elected for the purpose. This council meets on certain days in general assembly, to ascertain, in the presence of the directors, the state of the schools and to deliberate on the means of extending their usefulness.

Every member of the Industrial Society for promoting the establishment of schools, whether he have apprentices or not, is bound to pay a contribution calculated on such a basis that the total, with the addition of sundry subventions, will cover the whole probable expenses of the school during the current year. By so doing, he has the right to send his apprentices (if they have received the proper elementary instruction) to the school, without any further payment, except for writing and drawing materials. Apprentices, after becoming journeymen, cannot continue to attend the school without the payment of regular fees.

## 2. MANUFACTURERS' AND TRADESMEN'S SCHOOL OF PRAGUE.

In 1847, the Society for the Encouragement of Industry in Bohemia founded a Sunday and evening school for drawing and modeling in plaster for apprentices in Prague, which, in 1860, was extended in its range and thoroughness of instruction to the working classes generally. The plan was drawn up by an eminent engineer, who had studied the organization of industrial education in France and other countries, and adopted by the Diet of Bohemia and the council of the town.

The town provided a building for the establishment, as well as the furniture, and a yearly grant of 1,500 florins, the Diet voted 2,000 florins, and the Industrial Society engaged to give another 2,000 florins. The school, therefore, has a fixed income of 5,500 florins. The immediate superintendence of the school is entrusted to a council of three members elected by the Diet, three members of the municipal council, and three members of the Industrial Society.

The school was opened in 1863. The pupils are taught through the medium of both the German and the Bohemian languages, which, in some cases, renders two professors necessary for the subjects. The 16 professors are nearly all attached to the professorial staffs of the two higher practical schools of the town, in the different class-rooms of which the lessons are given.

The plan of studies for the year 1867-68 is as follows :

Sunday.	From 8 to 9 a.m.,	-	Technology.
	From 8 to 10 p.m.,	-	Practical weaving.
	From 10 to 12 a.m.,	-	{ Exercises in linear drawing. Exercises in free-hand drawing. Drawing of machines. Free-hand drawing of ornament.
	From 2 to 4 p.m.,	-	{ Exercises in linear drawing. Exercises in free-hand drawing. Drawings for construction of buildings. Free-hand drawing of ornament.
Monday evening.	One hour,	-	{ Lectures on machines. Chemistry.
	Two hours,	-	{ Natural history. Algebra and geometry.
	Two hours,	-	{ Drawing for construction of buildings. Modeling.

Tuesday evening.	One hour,	-	-	{ Arithmetic.
	Two hours,	-	-	{ Art of construction.
	Two hours,	-	-	{ Written compositions and style.
Wednesday evening.	One hour,	-	-	{ Chemistry.
	Two hours,	-	-	{ Drawing of machines.
	Two hours,	-	-	{ Modeling.
Friday evening.	One hour,	-	-	{ Drawing of patterns.
	Two hours,	-	-	{ Algebra and geometry.
	Two hours,	-	-	{ Lectures on machines.
Saturday evening.	One hour,	-	-	{ Art of construction.
	Two hours,	-	-	{ Lessons in ornamentation.
	Two hours,	-	-	{ Drawing of patterns.
Saturday evening.	One hour,	-	-	{ Physics and mechanics.
	Two hours,	-	-	{ Technology.
	Two hours,	-	-	{ Lectures on machines.
Saturday evening.	One hour,	-	-	{ Art of construction.
	Two hours,	-	-	{ Modeling.
	Two hours,	-	-	{ Geography.
Saturday evening.	One hour,	-	-	{ Natural history.
	Two hours,	-	-	{ Lectures on machines.
	Two hours,	-	-	{ Arithmetic.
Saturday evening.	One hour,	-	-	{ Book-keeping.
	Two hours,	-	-	{ Physics and mechanics.
	Two hours,	-	-	{ Modeling.

In winter evening classes are held from half-past six to half-past eight, and in summer from seven to nine o'clock. The lectures and drawing relating to the building arts end at Easter, those for other industries last from the beginning of October to the end of July. Candidates for admission to the preparatory school must be able to read, write, and calculate; and to attend the courses of the special divisions they must produce a certificate of capacity from the preparatory school, or from a lower real school. The fee is half a florin a year for each course attended; it is paid half-yearly, and in advance.

The technical and practical teaching is distributed into five principal divisions, according to the branches of industry in which the pupils are engaged.

The *first* is the school for the building trades, for masons, stone-cutters, carpenters, joiners, &c.; the instruction includes geometry, the elements of algebra, the art of building in general, drawing for building and modeling, notions of physics and mechanics, the effects of heat; these studies require two winter half-years. The *second* is the school for the construction of machines; for smiths, mechanics, conductors of machines, coppersmiths, modelers, joiners, &c.; they are taught geometry, the rudiments of algebra, the elements of physics and mechanics, the description and study of machines, and also drawing; these studies require two years. The *third*, or chemical school, is for dyers, brewers, tanners, soapboilers, &c.; the lectures treat of general chemistry and chemical technology. The *fourth* is the school for weaving and spinning; here the pupils are taught practical weaving, the calculations relative thereto, the preparations of the cards, taking out of patterns, &c. The *fifth*, or school of industrial art, is intended for manufacturers of porcelain and earthenware, glass blowers, goldsmiths, confectioners, &c.; the instruction consists of drawing and modeling.

At the close of the courses there are examinations, after which certificates of capacity are given to the deserving, and the two pupils at the head of each division receive prizes. The number of workmen who attended the Prague school in 1863-64 was 762. The expense was 5,900 florins, of which 2,380 was for professors, besides 1,620 for drawing and modeling.



## 3. MECHANICS' SCHOOL AT BRUENN.

In 1851, the Chamber of Industry and Commerce in Brünn (a city, in 1860, of 45,000 inhabitants,) stimulated by the government activity in the thorough organization of real schools, established a Mechanics' school with two sections, the elementary for apprentices, who are deficient in even primary education; and a higher for such additional studies as geometry, physics, free-hand, and geometrical drawing, besides lectures and practice in book-keeping, banking, and commercial correspondence. Chemistry is an optional study for ten hours a week.

The pupils are divided into three principal classes: (1) for builders, with a special winter course for masons, joiners, and stone-cutters; (2) for mechanics, including a special class in weaving; (3) for technical applications of chemistry.

The instruction is given on Sunday, and the evenings, and in the winter, one hour by daylight, on Thursdays, is secured for drawing. Besides, several special assistants; and in the weaving class, two foremen from the largest establishment in the city, twenty teachers from the real school, higher technical institute, and gymnasium, are employed. The school is free, and the attendance large.

## REAL GYMNASIUM OR PRACTICAL SCHOOL.

In 1867, there were 87 Real schools of the lower or three years' course, and 24 of the higher or five years' course. These are all located in the chief towns, but draw their pupils from all parts of the districts where they are placed.

## HIGHER PRACTICAL SCHOOL AT PRAGUE.

This school, the origin of which the Bohemians trace with justifiable pride through the successive transformations, which the progress of industry rendered necessary, to the year 1576, in the reign of Rudolph II., an epoch long anterior to the foundation of most of the schools now existing in Germany, follows the same programme of studies as the Vienna schools, as will be seen from the following table. The pupils, (513 in 1867,) are divided into six classes, requiring six years. The subjects of instruction and number of hours are indicated below.

	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.	Totals.
Religious instruction, -	2	2	2	2	2	2	12
German language, -	4	4	4	3-5	4	4	23-25
Geography and history, -	3	3	3	3-5	4	4	18-20
Arithmetic, -	4	4	3	-	-	-	11
Natural history, -	2	2	-	2	2	2	10
Useful knowledge, -	2	3	-	-	-	-	5
Bohemian language, -	3	3	3	3	3	3	18
Calligraphy, -	2	2	2	2	-	-	8
Freehand drawing, -	-	6	7	6	6	6	31
Chemistry, -	-	-	6	2	-	-	12
Construction of buildings, -	-	-	2	-	-	-	2
Mathematics, -	-	-	-	8	5	2	15
Linear drawing, -	-	-	-	-	4	4	8
Physics, -	-	-	-	-	4	4	8
Description of machines, -	-	-	-	-	-	2	2
Drawing of machines, -	-	-	-	-	-	2	2
Modeling, -	-	-	-	-	-	4	4
Geometry and construction drawing, -	10	4	-	-	-	-	14
Italian, -	} Out of class,					2	-
French, -						2	-
Stenography, -						2	-

The French commissioners remark: Of all the practical schools in Germany that of Prague is certainly the one where linear drawing is best taught, and we are inclined to attribute this fact to the attention given from the very outset to the practice of freehand drawing, which early habituates the pupil to trace his lines with a light hand.

The instruction is given in German and Bohemian, but the professors are free to choose which language they please. There are, in some cases, professors of each language for the same course. The class-rooms, amphitheatres, and laboratories are spacious and well arranged. The collections are well stocked with models, and the workshop for modeling will accommodate 25 pupils at once.

#### IMPERIAL HIGHER PRACTICAL SCHOOL AT VIENNA.

The Imperial gymnasium in the Landstrasse is accommodated in a building rented for the purpose, formerly the residence of Prince Lichtenstein. It has numerous collections, especially of mineralogy and natural history. Well arranged laboratories have been fitted up to enable the pupils who are so disposed to make themselves acquainted with the elements of chemical manipulation. There is a workshop for modeling, and the pupils are exercised in that art from a drawing, and conversely in drawing from models. The drawing-class rooms are very spacious and well lighted: the pupils have plenty of room. For drawing from the round or from models in relief, even elementary, there are cabinets or cells lined with green cloth, and in which the models are lighted by a single gas burner, so that the shadows may be more distinct.

The time devoted, weekly, to lessons and graphic exercises, under the eye of the professors, is distributed as shown in the following table:

	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.	Totals.
<i>Compulsory.</i>							
Religion, - - -	2	2	2	2	2	2	12
Arithmetic, - - -	4	4	3	-	-	-	11
Mathematics, - - -	-	-	-	9	5	2	16
German, - - -	5	5	4	5	3	4	26
Geography and history, - - -	3	3	3	4	4	4	21
Natural history, - - -	2	2	-	2	2	-	8
Physics, - - -	2	4	-	-	4	4	14
Chemistry, - - -	-	-	6	2	2	2	12
Writing or calligraphy, - - -	2	2	2	2	-	-	8
Freehand drawing, - - -	10	6	7	4	6	6	39
Descriptive geometry drawing, - - -	-	-	-	-	4	-	4
Linear drawing of buildings, - - -	-	4	3	2	-	-	9
Machine drawing, - - -	-	-	-	-	-	4	4
Lectures on machines, - - -	-	-	-	-	-	2	2
Modeling, - - -	-	-	-	4	4	4	12

The time, per week, allotted to optional studies, is as follows: English language, 5 hours; Italian language, 3; French language, 3; stenography, 2; singing, 2; gymnastics, 2.

We see by this table the immense importance attached to the teaching of freehand drawing, almost exclusively executed from models in relief. For the six classes it occupies 39 hours per week, whilst to linear drawing with rule and compass only 16 hours are given.



At the close of every year there is an examination, and marks are given; according to the results the pupils pass to the upper classes. According to the information and notes of each professor the pupils are classed, and any note stating deficiency in a single branch of instruction prevents the pupil from entering the upper class, and, on leaving, deprives him of the certificate of satisfaction required for admission to the technical institutes. It is evident, by these rules, that the system of outdoor pupils is compatible with strict discipline. When a pupil leaves the sixth class of a higher practical school with a certificate of eminence he is admitted *de jure* into the first class of the Polytechnic Institute, otherwise he must go through a year's preparatory studies. The examinations are very strict. The school fee at Vienna is 18 to 20 florins a year. The pupils who perform chemical manipulations in the laboratory pay an additional entrance fee of two florins and one florin per month. The reagents are furnished by the State.

## CITY HIGHER PRACTICAL SCHOOL IN VIENNA.

The Real gymnasium, located in the suburb of Wieden, founded by the city and administered by the municipal authorities, is of the same order as the Government School. The building is a very handsome one, and is most conveniently arranged. The class-rooms for drawing and study, and the laboratories, are large and well lighted, and there are very good collections of apparatus and models. Drawing is taught from objects and models in relief. Free-hand drawing receives far greater attention than linear drawing; the former has 38 hours weekly in the different classes, the latter only eight, and yet the results are satisfactory.

The subjects of instruction are distributed, per class and hours, as follows :

	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.	Total.
Religion, - - -	2	2	2	2	2	2	12
Arithmetic, - - -	4	4	4	-	-	-	12
Mathematics, - - -	-	2	-	9	5	2	18
German, - - -	5	5	4	5	3	4	26
Geography and history, -	3	3	3	4	4	4	21
Natural history, - - -	2	2	-	2	2	2	10
Physies, - - -	2	3	-	-	4	4	13
Chemistry, - - -	-	-	6	2	2	2	12
Writing and calligraphy, -	2	2	2	2	-	-	8
Descriptive geometry, - -	-	-	-	2	4	-	6
Free-hand drawing, -	10	6	6	4	6	6	38
Linear drawing of buildings and machines, - - -	-	2	2	-	-	4	8
Lectures on machines, - -	-	-	-	-	-	2	2
Construction of buildings, -	-	-	2	-	-	-	2
Total, - - -	30	31	31	32	32	32	

We see by this table that the distribution of time and lessons is almost identical with that adopted at the Imperial and Royal School in the Landstrasse. It is the same with regard to the selection of the subjects for drawing, which, after relating to questions of general education, are divided into distinct industrial specialties.

## POLYTECHNIC SCHOOLS.

The object of the technical institutions at Vienna, Prague, and Gratz, is, to give a thorough, scientific, and, so far as can be done, also practical education. Instruction is imparted in separate courses, (*Fachschulen*), of which there are four at Vienna and Prague; 1. Construction of roads, canals, bridges, &c. 2. Architecture. 3. Construction of machinery. 4. Technical chemistry. Other technical studies are not excluded, if they have reference to the above courses.

In Gratz, instead of architecture, there is a course of agriculture and forest economy. Likewise a course of surveying and meadow culture. At Gratz and Vienna the accessory studies, which form the general scientific basis of the separate courses (mathematics, physics, and drawing,) are taught in two general classes, which precede the separate courses of study. The other subjects of instruction are partly such as must be taught in the separate courses, in correspondence with the aim and object of the institution, partly such as offer an opportunity to students for other and deeper studies.

The students are classed as ordinary and extraordinary.

The ordinary students, for the first year's course at Vienna and Prague, must hold either a certificate from a real school or gymnasium, (besides giving evidence of some proficiency in free-hand and geometrical drawing,) or pass an examination on the studies of the same. To become an extraordinary student at any of the three polytechnic schools, the candidate must give proof of possessing sufficient preliminary knowledge to enable him to attend the lectures with profit.

In Vienna and Gratz, the ordinary students must follow strictly the plan of studies laid down for each year; unless, with the consent of the authorities a different plan for themselves has been formed. In Prague, the plan of studies is not obligatory. The free choice of lectures is permitted, with the only condition that satisfactory evidence is given of a sufficient preliminary knowledge.

The charge for tuition for ordinary students, in Vienna and Prague, is 50 florins; in Gratz, for ordinary and extraordinary students, 30 florins. The charge for the extraordinary students, at Vienna, is at the rate of 1 florin 50 kreuzers for each lecture (two drawing hours are counted as one). Extra lectures are to be paid for separately. Students, unable to pay, who show great abilities, may be allowed to study partly or totally free of charge.

The internal administration of these institutions is in the hands of a board of professors, at whose head is a rector, (called director at Gratz,) who is chosen annually by the professors. The choice must be confirmed by the government. In Vienna, he can only be chosen again after two years' interval. The rectors at Vienna and Prague have an additional salary of 1,000 florins; the director at Gratz, who is chosen annually from among the professors of some other technical school, has 500 florins. The board of professors is formed by all the ordinary and extraordinary professors and representatives of the tutors (*docenten*).

Each of the separate divisions has a president, who is chosen from among the ordinary professors engaged in each separate course of study, in Vienna for two years, in Gratz and Prague for one year. These presidents superintend the course of studies as well as the discipline of the students in each division. Each division has again its own board of professors, which settles the claims of students to dispense with one or the other course of studies, to decide in doubtful cases as to the admission of students, and their promotion to the next class.



## POLYTECHNIC INSTITUTE AT PRAGUE.

The Polytechnic Institute is intended to give the pupils who follow its studies a fundamental scientific education adapted to the profession they mean to adopt, and to make them so well acquainted with technical and scientific progress that they may be able without further preparation to enter on the duties of practical life. To attain this end, the instruction is distributed in four special divisions :

- A. Division, bridges, roads and civil engineering (*Wasser und Strassenbau*).
- B. Division of architecture and civil buildings (*Hochbau*).
- C. Division of the construction of machines (*Maschinenbau*).
- D. Division of applied chemistry (*Technische Chemie*).

The following instruction is common to all the pupils :

I.—MATHEMATICS. *Three courses of a year each.* 1st Course.—Algebra, analysis, elements of differential calculus, analytical geometry, plane and solid (7 hours). 2d Course.—Higher equations, integral and differential calculus, with applications to geometry (6 hours). 3d Course.—Differential equations, variations, calculations of least squares (5 hours).

II.—DESCRIPTIVE GEOMETRY. 1. Orthogonal projections, oblique and polar in general, with a view to technical applications, (5 hours); drawing of buildings (10 hours). 2. Stereotomy, application of descriptive geometry to cutting of stones and voussoirs (2 hours); execution of models in stone-cutting (4 hours).

III.—LAND SURVEYING. 1st Course.—Surveying, leveling, theory and description of instruments and apparatus (5 hours); topographical drawing from models (6 hours); practical surveying and leveling in the field (14 days in the year at least). 2d Course.—Contouring; geodesic leveling (3 hours); practice in the field (for 8 days in the year at least).

IV.—MECHANICS AND CONSTRUCTION OF MACHINES. 1. Elementary mechanics, terrestrial statics and dynamics, hydrostatics, hydrodynamics, aerostatics and aerodynamics (3 hours). 2. Analytical mechanics, in the summer term (5 hours). 3. Mechanics of constructions (3 hours); drawing of machines (6 hours). 4. Study of machines, application of mechanics to the theory and the drawing of machines (no time specified). 5. Construction of machines, knowledge of materials, and instruction in certain kinds of machines (5 hours). 6. Encyclopædia of machines, for pupils not destined for any specialty (5 hours); drawing of machines (6 hours). 7. Construction of machines in the workshop (at least 4 hours).

V.—TECHNOLOGICAL MECHANICS. Working of metals, wood, textile substances, spinning, manufacture of woollen tissues and of paper (5 hours).

VII.—ARCHITECTURE AND CIVIL ENGINEERING. 1st Course.—Mason's and carpenter's work, constructions in iron, materials of formation and stability of buildings (4 hours); designs of construction (no time given). 2. 2d Course.—Technical study of edifices, preparatory works, &c., (5 hours); drawing of buildings (6 hours). 3. 3d Course.—Project of a large building from a given programme (12 hours). 4. Studies of style with drawings (courses of 6 hours each); modeling in clay (6 hours).

VII.—HYDRAULIC CONSTRUCTION AND ROAD-MAKING. 1st Course.—Foundations, embankments, lakes and canals, construction of roads, resistance of bridges and railways (5 hours); drawings of constructions (no time given). 2d Course.—On bridges and railways (5 hours); drawing of ditto (8 hours); projects of hydraulic constructions and roads from a given programme (8 hours).

VIII.—GENERAL NOTIONS ON HYDRAULIC WORKS AND ROAD-MAKING. For pupils not destined for any specialty of construction (5 hours); drawing of buildings (6 hours).

IX.—GENERAL PHYSICS. 1. Statics, dynamics, magnetism, electricity, heat, optics, acoustics (5 hours). 2. Technical physics: application of physics to technical questions and industry, pyrotechny, telegraphy, galvano-plastics (2 hours).

X.—GENERAL CHEMISTRY. 1. Raw materials and their uses; working of metals, alloys; study of salts; organic chemistry (7 hours). 2. Analytical chemistry; use of the blow-pipe; qualitative and quantitative analysis, in winter (5 hours); practical analyzing in the laboratory (two courses of 15 hours each). 3. Technological chemistry: 1st Course.—Chemical fermentation (in winter);



agricultural chemistry, bleaching and drying (in summer, 5 hours). *2d Course.*—Manufacture of sugar (in winter, no time specified); manufacture of glass, chemistry of salts (in summer, 5 hours). 4. Chemical encyclopædia, for pupils not intending to follow any chemical speciality.

XI.—MINERALOGY. On the technical and industrial applications (in summer).

XII.—GEOLOGY AND PALÆONTOLOGY. Their technical and industrial bearings (3 hours).

XIII.—BOTANY. Technical and industrial applications (in summer, 3 hours).

XIV.—ZOOLOGY. Technical and industrial applications (5 hours).

XV.—FREE-HAND DRAWING. According to their special technical studies (4 hours).

#### SPECIAL SCHOOLS, OR DIVISIONS.

The course of special instruction occupies five years for the first three divisions of the first category of pupils (bridges and roads, architecture, construction of machines,) and four years for the fourth division (applied chemistry).

The subjects of instruction are spread over the successive years as follows :

#### DIVISION A.—*Bridges and Roads.*

*First Year.*—Mathematics, 1st course (7 hours); descriptive geometry (5 hours); working drawings (10 hours); general physics (5 hours); mineralogy (4 hours); free-hand drawing (4 hours). In all, 35 hours per week.

*Second Year.*—Mathematics, 2d course (6 hours); land surveying, 1st course (5 hours); drawing of plans (6 hours); elementary mechanics (5 hours); general chemistry (3 hours); technical physics (2 hours). In all, 27 hours per week; and during the summer 14 days practical surveying in the field.

*Third Year.*—Mathematics, 3d course (5 hours); analytical mechanics, and description of machines (5 hours); drawing of machines (6 hours); architecture (4 hours); drawing of buildings (6 hours); geology (3 hours). In all, 29 hours per week. Besides geological excursions.

*Fourth Year.*—Road-making and hydraulic works, 1st course (5 hours); drawing for ditto (8 hours); architecture, 2d course (5 hours); drawing for ditto (6 hours); mechanics of building (3 hours); cutting of stones (2 hours); practical modeling and stone-cutting (2 hours). In all 30 hours per week.

*Fifth Year.*—Road-making and hydraulic works (2 hours); drawings for ditto (8 hours); drawing of projects (8 hours); technical mechanics (5 hours); land surveying, 2d course (3 hours). In all, 25 hours per week, and also at least a week in the year in visiting remarkable engineering works.

#### DIVISION B.—*Architecture and Civil Constructions.*

*First year.*—Same as Division A.

*Second year.*—Same as Division A, plus 6 hours per week for the study of style, 1st course.

*Third year.*—Same as Division A, plus 2d course of style (6 hours).

*Fourth year.*—Same as Division A, plus 3d course of style (6 hours).

*Fifth year.*—Architecture and civil constructions, 3d course, drawing up of projects (12 hours); national economy (5 hours in winter, 4 hours in summer); account-keeping (3 hours); technical mechanics (5 hours); study of style, 4th course (6 hours); modeling (6 hours). In all, 33 hours per week, besides visits to interesting constructions.

#### DIVISION C.—*Construction of Machines.*

*First and second years.*—Same as Division A.

*Third year.*—Mathematics, 3d course, in winter; analytical mechanics, in summer (5 hours); drawing of machines (6 hours); encyclopædia of construction (5 hours); drawing of buildings (6 hours); geology (8 hours). In all, 30 hours per week.

*Fourth year.*—Construction of machines (5 hours); drawing of ditto (10 hours); projects of ditto (5 hours); technological mechanics (5 hours); technological



chemistry and metallurgy (2 hours): national economy, in winter (5 hours); account-keeping, in summer (3 hours); practice in workshop (4 hours at least). In all 35 hours, besides visits to great workshops.

*Fifth year.*—Practice in workshops.

#### DIVISION D.—*Technological Chemistry.*

*First year.*—Mathematics, 1st course (7 hours); general physics (5 hours); mineralogy (3 hours' lessons, 1 hour of application); zoology in winter, botany in summer (5 hours). In all 21 hours.

*Second year.*—General chemistry (7 hours); technical physics (2 hours); general mechanics (6 hours); drawing of machines (6 hours); geology (3 hours). In all 23 hours, besides geological excursions.

*Third year.*—Analytical chemistry, in winter (5 hours); analysis in laboratory (15 hours); technical chemistry, in winter (5 hours); agricultural chemistry, in summer (5 hours); encyclopædia of construction (5 hours); drawing of buildings (6 hours). In all 36 hours per week in winter, 31 in summer.

*Fourth year.*—Analysing in laboratory (at least 15 hours); sugar-making, iron-works, glass-making, pottery, and chemistry of salts (5 hours); national economy and account-keeping (4 hours). In all 29 hours per week.

It will be seen that in this programme the instruction given to mechanics is continued without interruption for four years, and that practice in workshops is required only in the fifth year, which appears preferable to the plan adopted at Dresden, of obliging the pupils to pass a year in the workshop after the first year's studies.

The institute has 20 ordinary professors, 11 extraordinary professors of the first class, 20 tutors, and 6 masters. The number of pupils in 1862–63 was as follows: Natives of Prague, 120; of Bohemia, 575; of Moravia, 14; of other parts of the empire, 38; total, 747. The age of the pupils ranged from 16 to 25, the great majority (526) being between 19 and 23.

The Prague Institute possesses numerous collections well supplied with the necessary appliances for teaching. They consist of—1. A library with from 10,000 to 12,000 volumes. 2. Complete sets of models for descriptive geometry, models of surfaces generated by straight lines, &c. 3. Instruments for topography, surveying, and leveling for the use of the pupils; topographical models in relief (Bardin's system). 4. Models of machines in great number and variety; parts of machines; apparatus to demonstrate the laws of falling bodies; dynamometers; divers prime movers. 5. Instruments for physical experiments, comprising most of the new inventions in that department. 6. Technology—different tools; raw products, &c. 7. Architecture—models in plaster; handsome models of suspension and other bridges in wood, iron, &c.; models of roofs and other carpenter's work. 8. Agriculture—well-executed models of farming machinery and implements. 9. Natural history and mineralogy—collection of minerals and rocks placed at the disposal of the pupils; birds, reptiles, &c.

The Institute has, for the study of applied chemistry, a complete laboratory, in which 40 pupils can simultaneously perform the principal manipulations.

The French commissioner remarks, "we found here linear drawing in the greatest perfection. The lines are fine and light; all the various kinds of working drawings are executed there, and the projects of public works, buildings, and machines are carefully got up."

## POLYTECHNIC INSTITUTE AT VIENNA.

The Polytechnic Institute in Vienna, as organized in 1815, was the culmination of efforts begun in 1765 to shape the instruction of the schools to meet the special wants of pupils in their future mechanical or commercial occupations. In 1835-36, we found it the best equipped school of its class (for mechanical and commercial industries) in Europe, and it was thus described by Prof. Bache.

THE whole institution is intended to fulfill a threefold purpose, as a school for the mechanic arts, manufactures, and commerce, as a conservatory of arts and manufactures, and as an institute for the promotion of national industry. The last named object is effected by public exhibitions, from time to time, of the products of manufactures, under the direction of the institute. For the better execution of this object, a spacious building is now erecting on the premises, adapted to the occasional display and permanent deposit of specimens of the mechanic arts. The collections which form the conservators of arts are also used for instruction in the school, and will be described in connection with it.

The whole institution is under the control of a director, who is responsible to the higher authorities of public instruction, and of trade and manufactures. The director is the general superintendent of the business of the institute and of the instruction, but does not teach. He regulates the admission of pupils and the discipline. The money concerns are under the charge of a treasurer, who is responsible to the director. The inferior officers are responsible to the same authority. The discipline of the scholastic department is simple but rigid, no pupil being allowed to remain connected with it whose department is not proper. The courses are gratuitous, except a small entrance fee, and this is considered as warranting prompt removal when the pupil does not perform the duties prescribed by the institution.

The department of instruction is composed of three schools, a technical, a commercial, and a "real school." The last named is a preparatory school for the two others, and may be entered as early as thirteen years of age. Its courses are of religious instruction, of German language, elementary mathematics, geography, history, natural history, elocution, calligraphy, and drawing, and are obligatory upon the pupils. Italian and French may be studied if the pupil desires it. As these courses lead in three years to the other departments of the institution, the candidates for admission are required to possess the elementary attainments necessary to their successful prosecution. There are five professors and four teachers connected with this school, which is superintended by the vice-director of the institute. The instructors rank by regulation with those in the gymnasias or classical schools of the empire. The course of instruction is not as comprehensive as that in the Prussian real schools, but is an adequate preparation for the next higher divisions, which supply in part these deficiencies.

The technical and commercial schools furnish special instruction according to the intended pursuits of the pupil, though he may, in fact, select the courses which he wishes to attend, not being limited as to the number or character of the branches. The director advises with the pupil, on admission, as to the studies most appropriate to be followed, if his intended calling is fixed, and he is not allowed to join the classes, the courses of which require preparation, without presenting a certificate from the school at which he has been instructed, or being examined, to ascertain his proficiency. In regard to other courses, there is no such restriction. The age for admission is sixteen years.

The instruction is given in the technical school by eight professors and two assistants; the professors lecturing, and in some of the courses, interrogating the pupils. Certain lectures are also gone over by the assistants with the classes. The courses which combine practice with teaching will be pointed out in enumerating the subjects of study. The division of these subjects, and the time devoted to them during the week, are as follows:

- I. GENERAL CHEMISTRY, applied to the arts, five hours.
- II. SPECIAL TECHNICAL CHEMISTRY, ten hours. This course gives a particular account of all the processes of the arts of which the principles were developed in the general lectures.



There is a special laboratory devoted to the course, where, under the superintendence of the professor or of his assistants, the pupils go through the processes on a small scale. Those who have a particular object in view, as dyeing, bleaching, printing upon stuffs, or the manufacture of chemical preparations or metallurgy, are directed in their investigations especially to the parts of chemistry which they will have to apply. Practice and theory are thus combined.

III. PHYSICS, with special reference to its applications, five hours.

IV. ELEMENTARY MATHEMATICS, including arithmetic, algebra, geometry, and mensuration, ten hours. This course is intended for those who have not passed through the real school.

V. HIGHER MATHEMATICS, five hours. There is a repetition by an assistant, also of five hours.

VI. MECHANICS, including the description and calculation of machines, five hours. This subject is founded upon a course of machines, considered as an application of descriptive geometry and drawing, superintended by an assistant.

VII. PRACTICAL GEOMETRY, including land and topographical surveying, levelling, &c., five hours. The lectures are accompanied by practice in the use of instruments in the field.

VIII. CIVIL and HYDRAULIC ARCHITECTURE, ten hours. This includes a complete course of engineering, in its various branches. It is accompanied by exercises in drawing.

IX. TECHNOLOGY, or a general discussion of arts and trades, five hours. The subjects which come under the head of special chemistry are omitted in the lectures of this division.

X. The assistant professor of chemistry delivers an extra lecture, daily, on the methods of measuring SPECIFIC GRAVITIES, during part of the course.

XI. Elementary DRAWING for those who have not passed through the real school, five hours. There are extra courses in the Latin, Bohemian, and English languages, for those who wish to follow them.

The time devoted to drawing depends upon the student, but it is obvious that his knowledge must be very incomplete, and that he will carry away from the school but an imperfect record of descriptive geometry and its applications, unless he devotes a great deal of time to this branch. In this respect the arrangement of the school is entirely different from that at Berlin, where the drawings accompanying the courses are made as much a matter of regular duty as the attendance upon the lectures themselves. This is certainly the proper plan, and while it appeared to me that the time spent in the graphic exercises at Berlin was even beyond the measure of their importance, I am decidedly of opinion that a strict attention to this department is essential.

The collections, by the aid of which these courses are carried out, are—1. An extensive collection of chemical preparations for both special and general chemistry. The pupils in special chemistry, as already stated, make preparations in the departments of the art which they intend to follow, and some of these are left behind them as specimens of their skill. In the department of the dyer there is quite a large series of specimens collected in this way. The laboratories for both special and general chemistry are admirably adapted to their purpose.\* 2. A cabinet of instruments for the course of practical geometry. 3. A considerable collection of physical apparatus. 4. A collection of models of machines, and in engineering. 5. A technological cabinet of a most complete character, and admirably arranged; it contains many of the best specimens of Austrian arts and manufactures. All these collections are under the care of the professor in whose department they find a place; there being, besides, curators for the immediate charge of them, and for keeping them in repair. The cabinet of physical apparatus, and of models and machinery, were in the main supplied from the workshops of the institution. These shops have long been celebrated for the astronomical and geodesic instruments furnished from them. They are still kept up, though on a reduced scale, their chief object having been accomplished. They were never intended, like those of Berlin, to afford practical instruction to the pupils. The institution, indeed, does not recognize the principle that this can be done to advantage in the mechanical department. It is certain, as already stated, that great care is required to render such establishments of any avail beyond the point of giving to the pupil a general readiness with his hands, and that even when well conducted they are expensive. Success in practical chemistry requires essentially a very considerable knowledge of theory; the processes on a small scale represent, in general, fairly those upon the large, and experiments thus made frequently save the outlay which is required to make them in the large way. The

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\* The laboratory of the professor of general chemistry, Professor Meissner, is one of the best arranged which I saw abroad. The furnace operations, and others likely to incommodate the class, are performed behind a screen, with large glass windows, which allow a perfect view: the space behind is provided with the means of carrying off the fumes.



practice in the laboratory of a school is, besides, very nearly of the kind required for the manufactory. These, among other circumstances render the problem in regard to successful preparation for the arts depending upon chemistry, different from that relating to the art of the machinist. It is in this department that the polytechnic school of Vienna is particularly strong. There can be no doubt that Austrian manufactures in general have received a great impulse through the medium of this institution, and particularly of its scholastic department, but while praise is yielded to the different courses, the arrangements for teaching chemistry must be considered as having a preference over the others.

The lessons in the commercial school embrace the following subjects :—

- I. Commercial correspondence, three hours per week.
- II. The science of trade (*Handelswissenschaft*), three hours.
- III. Austrian laws relating to trade and exchange, three hours.
- IV. Commercial arithmetic, six hours.
- V. Book-keeping, by single and double entry, four hours.
- VI. Account of the materials of trade. (*Waarenkunde*), the sources, uses, properties, kinds, adulterations to which they are subject, &c., four hours.
- VII. Commercial geography, three hours.
- VIII. History of commerce, three hours. There are five professors in this school.

Once a week the professors of the institute meet, under the presidency of the director, to confer on the business of the institution. Saturday is appropriated in part to this purpose, and there are no exercises for the students on that day. One of the professors is secretary of the board. The professors rank by regulation with those of the universities.

The lectures last from October to August of every year. At the close of them, a pupil who wishes a certificate in any branch, presents himself, and is examined by a professor, in presence of a director and of two members of the imperial commission of studies. A student who has attended the lectures, and does not wish to be examined, may receive a certificate of attendance.

To supply the place of a regular division of studies for different callings, one of the earlier programmes contained a recommendation of certain courses of study as preparatory to particular occupations. The recommendations were the following :—For tradesmen, the two years of the real school, and one year of the commercial school; or for a more complete education, an additional year, embracing the courses of chemistry, physics, and technology of the technical school. For dyers, printers in stuffs, bleachers, manufacturers of chemical products, of salt, of saltpeter, for miners, metallurgists, brewers, &c., special chemistry, physics, and technology, with some of the courses of the commercial school. For machinists, hydraulic engineers, mill-wrights, foremen in manufactories, and mining engineers—a course of two years was recommended, the first to embrace mathematics, physics, and drawing, and the second, mechanics, machine-drawing, and technology. As a preparation for agriculturists and foresters—courses of mathematics, physics, practical geometry, chemistry and book-keeping. For miners, mathematics, physics, practical geometry, mechanics, drawing, and book-keeping. For surveyors, mathematics, physics, practical geometry, drawing, and book-keeping.

There is still a regular course laid down for architects and civil engineers, the satisfactory completion of which entitles to a diploma. The first year includes elementary mathematics, technology, and drawing; the second, higher mathematics, physics, and drawing; the third, the applied mathematics, mechanics, practical geometry, and drawing; the fourth, architecture, engineering, drawing, technology, chemistry, and book-keeping.

The library of the institute is appropriated to the several departments, and is used by the students, as well as by the professors. Yearly appropriations, besides the entrance and diploma fees, are devoted to its increase. The professors have the right of recommending such works to be purchased as they may deem of use in their departments. An annual is published by the institute, consisting of original and selected scientific articles, by the professors, and notices of the institution.

To mark the advance in the subjects and courses of instruction, we give in detail, (1) the requirements for admission to either of the special divisions in 1868, and (2) the distribution of studies in the I. Technical Section; II. Commercial Section; and III. The Special Courses.



*Requirements for Admission into the Polytechnic Institution in Vienna.*

Candidates for admission as ordinary students into the Polytechnic Institution, are subject to examination in the subjects, and to the extent given below.

*a. Mathematics.*

1. *Arithmetic and Algebra.*—Ciphering in general, and calculation with common fractions and decimal fractions in particular; change of common fractions into decimal fractions, and continuous fractions, rule of three, reduction, chain rule, division; calculation, with logarithms; extraction of square and cubic roots of numbers; the rules of algebra; the properties of products and quotients, of powers, radicals, and logarithms; divisibility of numbers; greatest common measure, and least common multiple; properties of common continued fractions; outlines of the theory of combination; Newton's binomial proposition; simple equations with one and more unknown quantities, equations of the second degree with one and two unknown quantities, and equations of higher degrees with one and more unknown quantities, in as far as they can be resolved into quadratic equations; simple indeterminate equations; arithmetical and geometrical progression; calculation of interest.

2. *Plane Geometry; a.*—Planimetry; congruence, similarity, superficial contents, and transformation of rectilinear figures, more particularly of triangle and square; properties of the circle; lines and angles of the circle; its relation to the triangle, to the square, and to regular polygons; its periphery and contents.

*b. Goniometry and Trigonometry.*—The goniometric functions, their properties and mutual relations, and the more important formulas connected with them, particularly for the sums and differences of two angles, and for double and semi-angles; problems of the resolution of the triangle, and application of this calculation in given cases.

*c. Analytical Geometry.*—Proposition of the equations for the straight line and the circle in rectangular co-ordinates; problems relating to the straight lines and the circle; proposition of the equations for the ellipse, the parabola, and hyperbola from their definition; deduction of the principal properties of these lines, more particularly as regards the focus and the tangents.

3. *Solid Geometry; a.*—Stereometry; propositions and problems as to the relations between points, straight lines, and planes; properties of the parallel-pipedon, of the prism in general, of pyramids, of regular bodies; superficies and solid contents of angular bodies; properties of the cylinder, the cone and the sphere, their superficies and solid contents, lines and angles on the surface of the sphere.

*b. Spherical Trigonometry.*—Properties of the spherical triangle; problems for the solution of this; execution of the calculation in given cases.

In all these matters accurate understanding of the theory, as well as skill and certainty in the execution of the calculations is required.

*b. Geography and History.*

*Geography.*—Knowledge of the leading points of mathematical and physical geography, particularly of orography and hydrography; survey of political geography; knowledge of the most important branches of production, and of the internal relations of the leading countries; closer acquaintance with the political geography and statistics of Austria, particularly relating to the national and productive circumstances, and the state of civilization in the several portions.

*History.*—Synoptical knowledge of ancient history, more especially of Grecian history to the period of the downfall of the Macedonian Empire. As regards the history of the East, the development of the Egyptians, the Persians, and the trading colonies of the Phœnicians is more particularly to be held in view; the Hellenic states and constitutions during the heroic period; the wanderings of the Darians; the Greek colonies; the legislation of Lycurgus, and the Messinian war; Solon; the Persian war; the Peloponnesian war; the Theban war, and the leadership of Thebes; Philip of Macedonia; Alexander's expeditions into Asia; the fate of the States which were formed out of the empire of Alexander.

*Roman History up to the time of Augustus.*—The constitution of Rome during the time of the kings; the Republican constitution; the struggles between patri-



cians and plebians for equality of rights; the war with Tarento and Pyrrhus; the Punic wars; the Gracchi-Marius and Sulla; the first triumvirate; Julius Cæsar; the second triumvirate; Cæsar Octavian Augustus.

Survey of mediæval history, and more particularly of German history. Constantine the Great and the development of Christianity. The migration of nations and the founding of new empires. The Franks, Charlemagne. Dissolution of the empire of the Franks. The Saxon Emperors, especially Otto I, the Salic Frank Dynasty, Conrad II, Henry III, Henry IV, and Henry V. The Crusades and their consequences. The Babenbergs. Foundation of the power of the Hapsburgs. Charles IV and Wenzel. Sigismund and the ecclesiastical relations of his times. Germany under Frederick III and Maximilian I. The Italian republics of the middle ages.

More detailed acquaintance with the history of modern times, and more particularly with the history of Germany and Austria. Discoveries and inventions. The revival of art and science. The Reformation. Charles V, Philip II, and the Netherlands. The religious wars in France. Henry IV. The thirty years war. England under the Tudors, the Stuarts, Cromwell. France under Richelieu and Mazarin. The age of Louis XIV. The Austro-Turkish wars. Sweden under the Vasas. War of the Spanish succession. The northern war. Charles VI. The Silesian war and the war of the Austrian succession. Maria Theresa. Joseph II. The North American war of independence. History of the revolutionary period from 1789 to 1815.

### c. Physics.

The requirements are in—*a*. General knowledge: a perfectly distinct understanding of the fundamental principles of the science, and a knowledge of the most important phenomena in nature and of the laws that govern them, founded on experimental demonstration, and on elementary mathematical proofs.

*b*. Special knowledge: knowledge of the general properties of physical bodies, of the different forces working in them, of the various forms of aggregation, of the different degrees of solidity, of the laws of elasticity, adhesion, decomposition, crystalization.

In general mechanics, determination and measurement, combination, and resolution (*zerlegung*) of forces from a single point of attack, or from several points, the momentum of revolution (*Drehungsmoment*) and its composition, the simplest and most important of the complex mechanical principles of the theory of motion, uniform and irregular motion, velocity, combination, and resolution of motion, curvilinear motion, centripetal and centrifugal force, gravity, and the motion produced by it, projectile motion, oscillatory motion, revolving motion, point of inertia, free axis of rotation, impingement of elastic and of non-elastic bodies, resistance of motion, motion of working power and of vital force.

Theory of the balance, absolute and specific weight, influence of the earth's rotation round its axis on its form, and on the intensity of gravitation in different geographical latitudes, ebb and flood.

Fundamental principles of liquid bodies, form of the free surface and the conditioning causes, pressure on the bottom and the side walls of the containing vessel, and the practical applications to be deduced therefrom. Equilibrium in communicating vessels, the most important phenomena of capillary attraction, rising (*Auftreib*) equilibrium of floating bodies, determination of density by means of areometer and water poise, velocity of outflow under a constant amount of pressure, re-action of the jet and its applications, the shock of fluids, and the most important applications to water-wheels, turbines, &c.

General properties of elastic fluid bodies, measurement of elasticity, atmospheric pressure, and the measurement of this by means of different kinds of barometers, its variableness at different altitudes above the level of the sea. Mariotte's law and its most important applications; different kinds of air pumps. Determination of the specific weight of atmospheric air, and of the density of gases. Gay-Lussac's law: theory of the balloon, forcing pumps, siphons, &c. Laws of absorption, velocity of out-flow under constant uniform pressure.

Principal phenomena of magnetism. Outlines of the magnetism of the earth, magnetic point, magnetic axis, laws of distant effects of magnetism, methods of magnetising, paramagnetism, and diamagnetism.



Principal electrical phenomena, electrostatic induction, laws of distant action, and the production of such action by means of the revolving balance (*Drehwage*), the electroscope, the Leyden jar, and the condensator; electrophorical action, rapidity of the transmission of the electric condition, principal phenomena of contact electricity, laws of the gradation of tension, theory of the simple and complex voltaic piles, battery, current, physiological, thermal and chemical effects of the current. Principal features of electrolysis, the strength of the current, and its measurement by chemical effects. Effects of the magnetic current, galvanometers, multipliers, &c. Electrodynamical and magnetic-electric induction, thermo-electricity, idea of the resistance of conduction, Ohm's law, and its most important applications, bifurcation of the current. The leading points in the applications of the laws of electro-magnetism to telegraphy and electro-magnetic motors. Atmospheric electricity.

Leading points in the theory of undulation. Different kinds of waves, reflection and interference of waves, particularly of the waves of sound, rapidity of sound, conditions of sound, musical tones and determination of the number of their vibrations, tones of tightly strung cords, of bars, of sound-boards (sound figures), and of columns of air, reverberation of sound, structure of the organ of hearing.

Elements of the science of light. Elements of the theory of shadows, principles of photometry, reflection by plane and curved surfaces; simple refraction on plane and spherical surfaces (elements of the theory of lenses), distribution of color. Fraunhofer's lines, principles of spectrum analysis, achromatic prisms and lenses, chemical effects of light, optical instruments of certain construction (camera-obscura, camera-chiara, telescope, &c.), the eye and its structure, subjective phenomena of color, and diaphragmatic phenomena. Rapidity of the transmission of light, the most important phenomena of interference and refraction, the fundamental phenomena of double refraction, polarisation by refraction and reflection, color of laminae, explanation of these phenomena by the theory of undulations.

Principles of the theory of heat; expansion of bodies by heat, the thermometer, conduction of heat; change of the state of cohesion, latent and specific heat, the elements of calorimetry, generation of steam, laws of the tension of steam, determination of the density of steam, vapor contained in the atmosphere, hygrometry, the steam-engine. Radiating heat and the means of measuring the intensity of this, laws of radiation. Phenomena of combustion, heat caused by combustion.

#### d. Natural History.

*Mineralogy.*—The candidate should be acquainted with the most important of those properties of minerals by which they are characterized, and in accordance with these to determine and describe the most common minerals, or those which are most important as to their uses. But the knowledge of a definite scientific system of minerals is not required.

With respect to the general portions of mineralogy (characterization, terminology,) the examination will extend to:

1. Crystallography, embracing the morphological properties of minerals. A knowledge of the six systems of crystals according to the uses on which they are based, and according to their simple forms, as also of the most common combinations of two or more forms will be required. The knowledge of crystallographic symbols, or of calculating and measuring crystallography, will not be required.

2. Mineral physics embracing the physical properties of minerals: divisibility, hardness, and specific weight; brightness, transparency, color (idiochromatic and allochromatic) minerals, veins (*strich*); difference between minerals with simple and with double refraction, between magnetic and non-magnetic minerals; fusibility.

3. Mineral chemistry, or chemical properties of minerals; elements, combinations, equivalents, chemical constitution; difference between metallic and non-metallic minerals; definition of ores, (sulphurous, oxygenated, and saline ores,) of stones, (silicate,) and of salts, (carbonate, sulphate, &c.)

A knowledge of the chemical reaction of minerals is not required.



Among the most common, and most important minerals, as to their uses in special mineralogy are counted :

1. From among the group of *metallic* minerals.

a. The metals occurring in a pure form.

b. The most important ores, such as iron pyrites, magnetic iron, iron glance, red oxide of iron, brown iron ore, sparry iron ore, manganese, red ore of nickel, shining cobalt ore, copper ore, variegated copper pyrites, copper glance, red copper ore, malachite, lapis lazuli, sulphuret of lead, white lead ore, green and brown lead ore, tin-stone, shining silver ore, gray copper, red silver ore, cinnabar, sulphuret of zinc, lamellar calamine, sulphuret of antimony, arsenical pyrites.

2. From among the group of *non-metallic* minerals.

a. Sulphur and graphite.

b. The most important stones : quartz, opal, feldspar, analcime, staurolite, mica, chlorite, talc, serpentine, steatite, hornblende, augite, granite, vesuvian, cyanite, olivine, tourmaline ; also the most important of the precious stones ; the diamond, corundum, (sapphire and ruby,) topaz, spinel, zircon, beryl, (emerald.)

c. The most important salts ; calcareous spar, aragonite, gypsum, anhydrite, ponderous spar, celestine, apatite, nitre, fluor spar, rock salt.

The candidate must be able to indicate the most important morphological, physical, and chemical properties of all these minerals, as also their most important uses, and the localities in which they are principally found.

The knowledge of a systematic nomenclature (as for instance that of Mohs) is not required, nor either the chemical formulas.

*Botany and Zoology.*—In botany and zoology the candidate is expected to be able to give a systematic sketch of each of the kingdoms, and to possess a knowledge of the most important plants and animals which enables him to distinguish and characterize them. By the most important plants and animals are meant such as are especially interesting on account of their frequent presence in our country, of their application in arts and industry, of their usefulness, or their injuriousness, of the conspicuous place which they occupy in the household of nature, or of their peculiar geographical distribution.

Plants and animals of this kind will be laid before the candidate for him to classify and characterize.

As more important subjects of examination may be mentioned :

a. *In Botany* : principal organs of the phanerogamous plants ; forms of the roots, the pedicels, and the leaves ; blossoms ; various parts of the flower ; outer circle of petals, anther, stamen, pistil, and seed bud ; survey of the different kinds of fruits ; properties of the seed.

Characteristics of the cryptogamous plants in general. Linne's system.

Classification of plants according to the natural system.

Characteristics of the various classes of non-flowering plants, and the different orders of vasculiferous cryptogamia, (*Gefäßscrytogamen.*)

Characteristics, affinities, geographical distribution, and use of the most important families of seed-bearing plants.

b. *In Zoology* : the principal functions of animal life, motion, sensation, nutrition, and propagation ; indication of the most important organs connected therewith ; the local position of the latter in the animal body, and their nature in general must be demonstrated on one of the higher (vertebrate) animals ; influence of climate on animal life ; division of the animal kingdom into classes, (vertebrata, mollusca, &c.,) indicating the distinctive characteristic of each ; division of mammalia, birds, reptiles, and insects into orders. Distinctive characteristics of the various families of carnivora, of pachyderma, and of ruminata.

#### e. Geometrical and Free-hand Drawing.

Orthogonal projection ; representation of straight lines and planes ; graphic solution of problems relative to their mutual relations ; representations of bodies bounded by planes ; intersections of their surfaces ; representation of conic, cylindrical, and rotative surfaces ; their intersection with straight lines and planes, and their mutual intersections, as also their points of contact with planes ; application of this to the determination of shadows.

Elements of the method of perspective projection.

Free-hand drawing, to draw a head or an entire figure in correct outline from a model, and to draw an ornament with shading.



## I. TECHNICAL SECTION.

The course of instruction consists of a preparatory division comprising two years, and four special divisions, viz: 1. Bridges and roads. 2. Architecture. 3. Construction of machines. 4. Chemistry. The teaching commences on the 1st of October and ends on the 31st of July. It is divided into courses of a year, and courses of half a year. The subjects taught are:

A. Mathematics, descriptive geometry, practical geometry, higher land surveying, spherical astronomy, technical mechanics, analytical mechanics, general physics, technical physics, inorganic chemistry, organic chemistry, analytical chemistry, mineralogy, geology, zoology, palaeontology, and botany.

B. Study of machines, general elements of machinery, construction of machines, mechanics relating to construction, general elements of the construction of buildings, architecture and the art of building; bridges and roads, railways, description of soils; technical chemistry, knowledge of merchandise, agricultural and forest economy.

C. General history, history of Austria, history of the building art, history of the inductive sciences; German literature; aesthetics, political economy, statistics; mercantile law, law of exchange, maritime law; Austrian organization and administration; book-keeping.

D. Technical and free-hand drawing; decoration, and drawing of ornaments; landscape drawing; modeling.

E. French, Italian, and English languages; stenography.

These subjects are distributed between the preparatory and special divisions, and nearly the same number of hours is allotted to each, as in the Prague Institute just described. The lessons in botany, zoology, geology, mechanical and chemical technology, construction of machines, art of building, and in the agricultural sciences, are followed by excursions and visits to establishments. The practical course of geometry is also terminated by important field operations.

The following are studies, with the hours per week allotted to each:

*Preparatory Division.*

SUBJECTS.	WINTER.		SUMMER.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
FIRST YEAR.				
Mathematics, (1st course,) - - -	5	-	5	-
Descriptive geometry, - - -	3	8	3	8
Inorganic chemistry, - - -	2	-	2	-
Mineralogy, - - -	3	-	-	-
Geology, - - -	-	-	3	-
Technical and free-hand drawing, -	-	6	-	8
Total, - - -	13	14	13	14
SECOND YEAR.				
Mathematics, (2d course,) - - -	3	-	3	-
General physics, - - -	2	-	3	-
Technical mechanics, - - -	3	-	3	-
Practical geometry, - - -	3	6	3	6
Technical and free-hand drawing, -	-	8	-	10
Total, - - -	11	14	12	16

I.—*Division of Bridges and Roads.*

SUBJECTS.	WINTER.		SUMMER.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
FIRST YEAR.				
Stereotomy and perspective, - - -	-	-	3	6
Surveying, - - - - -	3	-	2	-
Analytical mechanics, - - -	3	-	-	-
Elements of machinery, - - -	3	6	3	6
Construction, (1st course,) - - -	4	8	4	8
Total, - - - - -	13	14	12	20
SECOND YEAR.				
Technical physics, - - - - -	2	-	2	-
Applied mechanics, - - - - -	3	-	-	-
Mechanism, - - - - -	2	-	2	-
Land surveying, - - - - -	-	-	1	4
Bridges and roads, - - - - -	3	-	3	-
Projects and construction, - - -	-	15	-	15
Total, - - - - -	10	15	8	19
THIRD YEAR.				
History of constructive art, - - -	3	-	-	-
Organization of construction, - - -	1	-	-	-
Construction of bridges, - - - - -	2	-	2	-
Construction of railways, - - - - -	2	-	2	-
Projects, - - - - -	-	15	-	20
Total, - - - - -	8	15	4	20

II.—*Division of Architects and Buildings.*

FIRST YEAR.				
Stereotomy and perspective, - - -	-	-	3	6
Elements of machinery, - - - - -	3	6	3	6
Constructive mechanism, - - - - -	2	-	2	-
History of constructive art, - - - - -	3	-	-	-
Architecture, (1st course,) - - - - -	4	8	4	8
Total, - - - - -	12	14	12	20
SECOND YEAR.				
Technical physics, - - - - -	2	-	-	-
Applied mechanics, - - - - -	3	-	3	-
Elements of construction, - - - - -	-	-	3	6
Architecture, (2d course,) - - - - -	5	-	5	-
Architectural drawing and projects, -	-	14	-	14
Total, - - - - -	10	14	11	20
THIRD YEAR.				
Organization of construction, - - - - -	1	-	-	-
Architecture, (3d course,) - - - - -	3	-	3	-
Projects, - - - - -	-	15	-	15
Total, - - - - -	4	15	3	15



III.—*Division of Mechanics.*

SUBJECTS.	WINTER.		SUMMER.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
FIRST YEAR.				
Technical physics, - - - -	2	-	2	-
Elements of construction, - - -	3	6	3	6
Analytical mechanics, - - - -	3	-	-	-
Machinery, - - - - -	-	-	4	-
Machine construction, - - - -	3	-	3	-
Manufacture of machines, - - -	-	10	-	10
Total, - - - - -	11	16	12	16
SECOND YEAR.				
Constructive mechanism, - - -	2	-	-	-
Applied mechanics, - - - - -	3	-	3	-
Apparatus for warming and lighting,	1	-	-	-
Metallurgy, - - - - -	2	-	-	-
Machine construction, - - - -	3	-	3	-
Projects and manufacture, - - -	-	15	-	15
Total, - - - - -	11	15	6	15

IV.—*Division of Applied Chemistry.*

FIRST YEAR.				
General physics, - - - - -	2	-	3	-
Applied mechanics, - - - - -	3	-	3	-
Botany, - - - - -	-	-	3	-
Zoology, - - - - -	3	-	-	-
Organic chemistry, - - - - -	2	-	2	-
Analytical chemistry, - - - -	1	-	-	-
Manipulation in the laboratory, - -	-	10	-	10
Total, - - - - -	11	10	11	10
SECOND YEAR.				
Technical physics, - - - - -	2	-	2	-
Elements of construction, - - -	3	-	-	-
Technology of mechanics, - - -	3	-	3	-
Acquaintance with raw materials, -	-	-	2	-
Metallurgy and salt works, - - -	2	-	1	-
Materials for heating and lighting, -	1	-	-	-
Manufacture of salts, glass, &c., -	-	-	3	-
Manipulation in the laboratory, -	-	10	-	10
Total, - - - - -	11	10	11	10
THIRD YEAR.				
Elements of machinery, - - - -	3	-	3	-
Printing, dyeing, bleaching, &c., -	5	-	-	-
Fermented liquors, manufacture of sugar, soap, stearine, &c., - - - -	-	-	5	-
Manipulation in the laboratory, -	-	15	-	15
Total, - - - - -	8	15	8	15

II. COMMERCIAL SECTION.—The course of instruction comprises the following subjects:

1. Commercial science, giving a complete exhibit of commercial economy, of arts and manufactures, commercial affairs in relation to the statistics of the population and the commercial history of the world: 5 hours per week.

2. Commercial law, legislation with regard to commerce, maritime law, &c.: 3 hours per week.

3. Commercial composition, ordinary commercial style and correspondence: 5 hours.

4. Commercial calculations, with special reference to the principal practical applications of political arithmetic: 5 hours.

5. Book-keeping—book-keeping as a special science, and as applied to commerce and industry: 4 hours.

6. Knowledge of goods; the qualities and properties of different products, materials, and manufactures: 3 hours.

7. Commercial geography: 3 hours.

8. Statistics, from an industrial and commercial point of view: 4 hours.

9. History of the Austrian constitutional law: 2 hours.

10. History of the Austrian administrative law: 2 hours.

III. EXTRA COURSES.—Connected with the Polytechnic Institute, special courses are given in:

1. Mechanical constructions, comprising the application of mechanics to architecture and the art of constructions: 3 hours.

2. National political economy, with special regard to arts and manufactures: 2 hours.

3. History of Austrian commercial law: 1 hour.

4. Spheric astronomy: 3 hours.

5. Science of the guarantee of capital and interest. This comprises an exhibit of the development of this science, its usefulness and its importance, and an exhibit of its theoretical basis.

6. Instruction in first surgical aid to be rendered in cases of accidents resulting from certain industries: 2 hours.

7. Calligraphy: 2 hours.

8. Stenography (Gabelsberger's system): 3 hours.

9. German literature; Commentaries on the life and poetry of Goethe: 2 hours.

10. Organic chemistry; Alcohols.

11. General and microscopic vegetable anatomy, (during the winter half-year.)

12. Vegetable physiology in its relation to agriculture, (during the summer half-year.)

IV. SCHOOL OF LANGUAGES.—Instruction is given in the following languages: Turkish, 5 hours; Persian, 5 hours; Arabic, 6 hours; Italian language and literature, 6 hours; English language and literature, 3 hours; French language and literature, 5 hours.

V. SCHOOL OF INDUSTRIAL DRAWING.—1. Elementary drawing, comprising: (a.) Drawing from nature: figures, plants, ornaments, &c.; (b.) Descriptive geometry; (c.) drawing of projections and perspective.

2. Technical drawing, comprising all the varieties of drawing applied to the designing and construction of models intended for spinning, printing tapestry, &c.

3. Drawing applied to the arts of construction and metallurgy.

4. Popular course of machine-drawing, with explanations of the construction and the working of machines.

The drawing-classes are open every day from 8 to 12, and on Sundays from 9 to 12.

The whole Institute numbers: 19 public and ordinary professors; 1 public extraordinary professor; 1 assistant professor; 7 tutors; 6 private professors; 2 extra tutors; 18 assistants; 3 librarians; 2 superintendents of the technological museum; 2 superintendents at the astronomical observatory.

The technological museum comprises more than 200,000 specimens of models, machines, &c., admirably arranged.



## GENERAL ORGANIZATION OF THE EUROPEAN POLYTECHNIC SCHOOLS.

(Extracts from Prof. Koristka's account of Higher Polytechnic Instruction in Germany, France and Switzerland).\*

The Polytechnic schools are the creation of our own day. Not one of them is a hundred years old, for the oldest, that in Paris, was founded in 1794. Then followed the school of Prague, 1806, (begun, it is true, as a special school, in 1765); Vienna, 1815; Berlin, 1821; Carlsruhe, 1825; the Paris central school, (*école centrale*), 1829; Munich, 1827; Nuremberg, 1829; Augsburg, 1833; Stuttgart, 1829, then Hanover, 1831; in Belgium, Liege, and Ghent, 1835, and at length, within the last twenty years, the new polytechnic institutes in Austria, and also certain beginnings in England. At the same time, we must mention that only a few of these schools in Germany received in the beginning the name or had the full character of polytechnic schools. They were founded under the name of Industrial Schools, extended their scope gradually, and at length received the new designation as well as their present internal organization.

The first schools of this kind, both in Austria and in Germany, comprised all technical subjects which the scholars were obliged to learn in turn. In the beginning, while industry was little developed and technical knowledge little cared for, these institutions answered fully to the demand, and the schools of Vienna and of Prague were, at that time, considered model institutions. But through the rapid advances of art and industry in our day, these schools did not need so long a time, as did those of former times, to divide themselves into groups. In the course of twenty to thirty years followed the division of labor, and with this came the problem: how to extend the single schools so that those who desired it could carry on exhaustive studies on particular subjects, and on the other hand, to provide for a general course, taking up all branches as formerly. It was found impossible to unite these two aims.

Necessarily, then, those schools, which wished to supply the new demands of technical knowledge and industry, were gradually obliged to alter their organization; to fulfil especially the chief requirements of the same; to introduce more exhaustive courses, so that, for instance, a course which originally consisted of instruction in mechanics was divided into two parts, theoretical and practical mechanics, afterwards into three parts, when the construction of machines was added to the two former studies, and later yet special instruction was given in the making of steam-engines and locomotives.

It was the same with the art of building, and with technical chemistry. Almost all the schools in Germany, Belgium, and France, yielded sooner or later to this practical necessity, and so arose the organization of the so-called *Fach*-schools, i. e., schools in which particular branches of business are taught.

In Austria, however, and in some parts of Bavaria, the old order of things remained, for which they offered as excuse the actual state of industry and the little need of a present division of labor; but they were at length obliged to yield.

True, Hanover did not accept the organization of schools for particular industries (*Fachschulen*), but it has been found, on comparing the plans of their schools with those of Carlsruhe or Zurich that they differ only in name. Still, there was wanting in Hanover the plan of supervision adopted in the special schools, and

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\* *Der noehere polytechnische Unterricht in Deutschland, in der Schweiz, in Frankreich, Belgien und England.* Carl Koristka, Prof. am polytechnischen Landesinstitut zu Prague, &c.

with this the conferences of the teachers seemingly so necessary to their prosperity; but this also was not long wanting. Finally, we might add that according to the plan of education in Paris, there was no real division for special studies there also, but all that has been said of Hanover applies to Paris as well, and besides, there the lectures of the professors form but a part of the instruction. Instruction by recitation forms a feature of even more importance, and the pupils were certainly divided according to their intended pursuits.

As for the number of the divisions, we find in all the schools at least four: chemical, mechanical, architectural (the latter divided into two parts, that of building with especial attention to architectural ornament), and that of highways, railways, bridges, &c., styled in France and Belgium *des ponts et chaussées*.

These four groups form the principal divisions in most polytechnic schools; only a short time ago, Berlin transferred the building department from the industrial school to the academy designed for this special study, but in Dresden both branches of building are united. In Belgium the schools at Liege and at Ghent are connected with each other.

The division of technical studies into these three or four distinct parts is so decidedly demanded by the nature and practice of technical science, that it is unnecessary to defend or support it here.

Another question is, whether the whole field is occupied by these four groups, or if others are not necessary. It cannot be denied that there is a great number of branches, which it would have been better to confide to special schools: as for instance, mining, foundries, agriculture, forest culture, ship-building, &c., not to speak of military fortifications. There is no doubt that one might give special instruction in these in the polytechnic schools just as well as in mechanics, chemistry, &c., provided thorough instruction in these branches is desired. Meanwhile, at the same time with the polytechnic schools, even earlier there arose, at Freiburg, Schemnitz, Mariabrunn, Tharand, Altenburg, Hohenheim, &c., special schools where practical as well as theoretical instruction was imparted with great success.

This further division has resulted only in profit to the polytechnic schools, their organization becoming more simplified, and united action being much facilitated. Some of them possess one or more of these special schools besides the before-mentioned, as, for instance, Zurich has a forest-school, Carlsruhe a forest, mercantile, and post school, Berlin a ship-building department, Liege a mining school, &c.

No one will deny that almost all branches of science are in some way, more or less, connected, and that it is, without doubt, very necessary and desirable that the intelligent workman (*techniker*) should know something out of his own narrow field. This argument was for a long time the chief weapon of the defenders of the old state of things in Austria; according to their notions, the artist should have made himself thoroughly familiar with a course of general study. But certain as it is, that a mechanic should possess sufficient knowledge of building as to be able to judge a plan accurately, so sure is it, that at present one no longer expects from a machinist that he should be able to plan and superintend the building of a railway, nor from an architect a chemical analysis; and the change, moreover, is regretted by no one. In order to meet the real necessities of the case, lectures on the most practical and important parts of other branches of science should be judiciously given.

In almost all the polytechnic schools, we find one or more general classes, in



which those things are taught which form the common basis of all technical knowledge, or which give the pupils superior culture, Karlsruhe has three, Stuttgart two, Dresden one, Berlin, Liege, and Ghent, one or two such general classes; in Paris the whole polytechnic school, consisting of two classes, is nothing more than a general preparation for the special departments. Even in Zurich, where there was formerly great opposition to this plan, a preparatory class has lately been formed, although these classes are very much opposed, there are certainly branches on which all technical science, in every department, is based, such for instance as higher mathematics, physics, with the geometry involved in it, which might be taught with advantage in one or two general mathematical classes, which all pupils, without exception, would pass through. We cannot demand of these preparatory schools that they give their pupils the pure discipline of science, so far as is necessary in the polytechnic schools, but on the other hand, since these subjects, which really demand a riper judgment for their comprehension, are to be taught in the polytechnic school, this leaves time to the pupils during the one or two years they pass in the preparatory school, to choose their occupation or profession.

Let us sum up in a few words the present organization of the polytechnic schools: First, one grand division consisting of one or two classes, and open to all scholars in common; then four branches for the four technical divisions, for building, architecture, mechanics, and chemistry, to which special courses may be added with advantage.

#### PREPARATORY INSTRUCTION.

A preparation for entering the Polytechnic Schools, in both Germany and Switzerland, can be sought in private or even self-instruction, since examinations are always held on entering the schools, and it is not necessary that the candidate should have been through any particular school. Meanwhile, it is plain that this method is very uncertain and expensive, and therefore, in all countries, where polytechnic institutions have been established, preparatory schools have also been established wherever they did not before exist.

These latter schools have, however, not the aim alone of preparing for the polytechnic school, but instruction for the middle classes of the industrial population is joined with it, is indeed for the most part, the real aim, preparation for the polytechnic school being only a minor end. Many polytechnic schools of Hanover and Dresden give this preparatory instruction themselves, either in a preparatory course or in their lowest classes.

The different names of these preparatory schools are: Trade (*gewerbe*) schools, (schools for artisans), real schools (schools where modern languages and the sciences are taught), real gymnasiums (corresponding to the American High School), industrial schools, &c. These must be carefully distinguished from the secondary and other improvement schools mainly for mechanics, which admit only artisans and work-people as scholars, and give instruction mostly during the evening and on Sundays. As chief representatives of this class of schools, we would mention the "Canton schools for artisans" (*Kanton-Industrieschulen*), "the district school for artisans" (*Kreisgewerbeschulen*), and the projected school of language and science (*Realgymnasien*) in Bavaria, and the "provincial schools" for artisans (*Provinzialgewerbeschulen*) of Prussia.

The chief branches of study everywhere are the elementary mathematics and drawing, further thorough instruction in the mother-tongue, physics, and foreign

modern languages. In mathematics the course goes at least as far as the use of logarithms, equations of the second degree, plane trigonometry, and in the Swiss schools still further. We cannot of course dwell longer on these schools here, our only object being to see the requirements for entering the polytechnic schools.

The schools for artisans, of Switzerland, form generally a second division of the canton-schools, whose first division is the gymnasium. The case is the same with the industries-school at Zurich. It forms, together with the gymnasium there, the admirably organized canton-school, which is directly connected with the common-school (*Volksschule*). The industrial-school has the work of preparing the pupil directly for practical life or for admission to higher technical schools. It is divided into an upper and lower school, each of which has three sub-divisions. The hours of instruction, per week, are specified. In the lower industrial school are taught: religion 6 hours, German language 12, geography 5, history 8, natural history 4, natural philosophy 4, practical arithmetic (including decimals and proportions) 9, mathematics, including fundamental rules and equations of the 1st and 2d degree, 4, geometry (planimetry and measurement of bodies) 6, geometrical figures 6, French language 16, English language (not obligatory) 8, (free-hand drawing) designing 8, calligraphy 4, singing 3, gymnastics 6, use of weapons.

In the upper school all these branches (gymnastics and use of weapons excepted) are not obligatory. Pupils can enter any one of the three principal departments, that of mechanics, of chemistry, or of commerce, into which the instruction is divided. The rector is, however, required to see that in the choice of branches by the scholar, he does not take special studies alone and entirely neglect the general branches. Every scholar must be occupied at least thirty hours a week. In the upper school are taught: religion, only in the first year, 2 hours, theoretical mathematics, continued fractions, logarithms, progressions, algebraic analysis, higher equations, plane and spherical trigonometry in full, analytical geometry 20 hours a week in all three year courses, geometry by figures 6, technical design 18, practical geometry, with simple field-measurements and designs, 7, theoretical mechanics, and mechanical technology, 6, chemistry and chemical technology with practice in the laboratory 10, lectures 8, exercises, botany and zoology, 3, mineralogy 2, knowledge useful to merchants, in seven courses, 26, French 11, English 12, Italian 10, German 7, history 12, geography 5, free-hand drawing 10, calligraphy 2, singing, gymnastics, and the use of arms.

The canton-school at Zurich is admirably arranged. The total number of scholars at the industrial school, in 1861, was 370. As soon as there are over forty scholars in a class a division is made.

The Provincial schools for artisans (*Kreisgewerbeschulen*) and the gymnasium for language and science (*Realgymnasien*) of Bavaria, which we wish to bring up as a second example of the preparatory instruction, have the same double aim as the first mentioned example. According to the present organization these schools have a three years' course divided for industrial occupations and commerce. The following branches are taught: higher arithmetic 5 hours, elementary mathematics, including logarithms and plane trigonometry, 12, natural history and encyclopædia of science 10, physics 3, practical chemistry 5, religion 6, German 10, geography 6, sketching, projecting, and designing, 24, calligraphy 2, modeling in clay 8, those who are to be merchants take, instead of the drawing and modeling, French and English, 10, mercantile, arithmetic, and counting-



room knowledge, 15. An important reform is projected (carried out in 1864) for these and all technical schools in Bavaria, so that the school of science is alone to fit this class of pupils, while the real gymnasiums are to take a middle place between these and the polytechnic schools. This is to have a four years' course, and to teach the following branches: mathematics, arithmetical equations, the study of functions, plane and spherical trigonometry, 25 hours, natural history 5, physics and chemistry 10, geometry by figures 6, designing 24, religion 8, German 9, Latin 10, French 16, English 4, geography and history 7.

In several of the greater States of middle Germany already such real gymnasiums exist, and it is not to be denied that there are many good reasons for organization. They give, in truth, a second drill, and are often used as a preparation for the polytechnic schools. The provincial schools for artisans throughout Prussia have a similar organization, and such ought really to be organized in every capital city. Each of these schools have only two classes and a one year's course. These are especially designed for boys of 14 at least, that they may there obtain that instruction necessary to them in their business, or prepare them to be received into the Trade Institute at Berlin.

The following are the branches taught with the number of hours devoted to them: elementary mathematics, including logarithms, equations of the second degree and progressions, plane trigonometry and conic sections, elements of descriptive geometry, 21 hours, physics and chemistry, with experiments, 12, mechanics and instruction on machines 3, instruction in building 3, mineralogy 2, designing and modeling 14, sketching 18. The lower class is chiefly for theoretical instruction and drawing, the upper for the practice of what has already been learned.

Besides these there are, in Germany, a great number of similar schools under the name of real schools, as at Darmstadt, &c., or higher district schools, people's schools, as at Hanover, which undertake, also, the courses of a gymnasium, and usually accomplish the whole in from six to seven years.

MECHANICS — INSTRUCTION ON MACHINE BUILDING AND MECHANICAL TECHNOLOGY.

	LECTURES.		DRAWING.		Teachers.
	Terms.	Hours.	Terms.	Hours.	
Zurich, - - - -	10	38	4	48	4
Carlsruhe, - - -	6	24	2	20	4
Stuttgart, - - -	5	24	3	24	4
Dresden, - - - -	10	35	2	36	3
Berlin, - - - -	11	26	9	28	5
Hanover, - - - -	6	31	2	16	4
Paris, (Central School)	7	14	3	..	6
Liege, (School of Arts)	5	18	3	32	3
Prague, (old plan)	2	15	1	10	2
" (new plan)	8	33	4	32	4

In no field of technical science has such great progress been made in the last thirty years as in that of mechanics. In no branch of study, therefore, is the difference between our Austrian and foreign institutions of learning so great as in this, and that also as much in the manner of teaching as in the arrangement of the subjects taught and the helps used.

While with us, in Prague and in Vienna, last year [1862] the whole subject, excepting mechanical technology, was taught by a single teacher in a single course of a year with from five to ten weekly hours of instruction, the same subject has been divided in Germany into three individual branches with at least one teacher for each branch.

Theoretical and analytical mechanics, and machine construction, are the chief branches taught at every good polytechnic school, and the last mentioned is even divided into two or more branches besides the necessary instruction in drawing and construction. We need only to glance at the figures of the foregoing table in order to see how far behind the others we are. Certainly, it heightens the merits of the Austrian teachers of mechanics, who thus, in the short time granted them by the school-programme of instruction, must go over the whole extended subject with its branches, and every unprejudiced person will acknowledge that they have accomplished much under the unfavorable circumstances.

As for the division of the subject, this is described in the account of the schools at Carlsruhe, Zurich, Dresden and Berlin. We will only add a few remarks; and first, the school at Zurich differs from most others, in the opinion that different courses of lectures shall be given on the theory of machines (*maschinen-lehre*) and on their construction (*maschinen-bau*) but that these lectures shall be given by separate professors, while other schools, particularly Carlsruhe, consider this impossible, or, at least injudicious.

It is certainly true that the theory of machines differs from machine-building, and that, since Redtenbacher, Weissbach, and especially Reuleaux, have brought the latter to an independent art, a union of these two subjects under one teacher can scarcely exist without more or less neglecting one or the other. On the other hand, we must also acknowledge that, since both subjects complete each other, the lectures must be so arranged that this difficulty can only be overcome by the most friendly understanding between the two professors, as happily is the case in Zurich at the present time.

In France, it is only lately that the new opinions have been adopted. By the old plan mechanics were taught in two branches: theoretical and practical, the latter being divided into several courses, as hydraulic machines, steam-machines, &c. With their excellent mathematical apparatus, the French technical teachers explained with ease the general principles involved in every machine, regarding each as an independent example, but their defect lay in paying little regard to empiricism, while the English fell into just the opposite mistake, and devoted themselves exclusively to proportions and to innumerable experiments and proofs.

A second remark has reference to machine shops as to whose introduction into the Austrian schools there is such difference of opinion; the call from business men (*industriellen*) being so loud for such workshops, that to appease them the scholars should become finished mechanics before coming to them.

It would be well to take counsel from the experience of the schools mentioned in the first part of this report. The institute at Berlin has the greatest and oldest arrangement of this kind. The work-shop costs over 9,000 thalers yearly, but the interest shown by the scholars is very little, and all competent judges at Berlin desire it to be discontinued or greatly limited. Then come Augsburg and Nuremburg, where the work-shops are on a more modest scale, but where, on account of the severe discipline and the small number of scholars (not over twenty), the results have been most favorable. Then we must mention Liege,



where the work-shops are leased to a machinist, and where, also, a very practical arrangement is made with regard to agriculture. In our opinion, although the number of scholars is even smaller, the results are even more favorable. In all other schools the machine-shops, whenever there are any, are considered as side-affairs, as in Carlsruhe and Zurich. In Hanover, Dresden, and the central school of Paris there are no such work-shops for scholars. Dresden gives the most instruction in this respect. True, there were no machine-shops arranged for the school, but the government had made a contract with one quite celebrated, by which the scholars were permitted to work there a certain number of hours, weekly, during the whole course, and to receive instruction there. In the year 1829, these hours comprised 48 per cent. of the whole time of instruction, but it diminished yearly, the lectures and exercises in designing being increased at its expense, so that, in 1835, it was only 35, in the year 1838 only 26, in 1849 only 14 per cent., and in 1852 was wholly discontinued.

All these results speak in no way favorably for the work-shops. It is also in the nature of the case that their establishment can never have the expected results in most polytechnic schools; for, in the first place the costs of such a workshop, and its yearly support, is very considerable. Secondly, only a few scholars can be taught, for it is impossible to instruct 60 to 80 scholars, which is the number at Vienna and Prague, without enormous outlay. Thirdly, the matter must be regarded in an economical point of view, as it is plain that in a private machine-shop much more economy of time and work can be practiced than at such a public school. Finally, the milder discipline of a polytechnic school is a hindrance to success, since the pupils are under no more strict regulations in their practical work than in their theoretical studies, and yet, as every one knows, the severest discipline, the most exact observance of the hours of labor, is necessary in a machine-shop (*fabrik*) if anything is to be accomplished, and order to be sustained. The opinion of those who think that young men are only spoiled in the shops is therefore not wholly without reason. But should a school which has large means and few scholars wish to establish such work-shops, we would recommend the method of Liege, or that of Augsburg and Nuremberg.

But what shall we do then? How shall young mechanics fit themselves, practically, for their work?

We reply, that a part, and that a very important one of the practical education, consists in a systematic study of machine-building, as that, at present, is taught in the better polytechnic schools, the great industry in the construction and designing of machines in the school itself. But we can never demand from a school that it should instruct the pupil in all the practical points relating to machine construction as thoroughly as the work-shop can do with regard to the single machine, to whose construction it has been dedicated for years. If, however, we demand this kind of practice, it can be obtained only by the pupil's taking practical lessons in a machine-shop either before his entrance into the school or after he graduates. The easiest method, and the one we would recommend, is the one in present use in Dresden and proposed at Stuttgart, namely, that the scholar enter upon this practical part after the first year passed at the school, for reasons previously given. In Austria little attention has as yet been given to this branch, and provision for the scholars in home institutions, since many of these are in the hands of foreigners, is extremely difficult. To help the scholars in this respect, the school-committee should make a contract with the best manufactories (*Fabriken*) to receive yearly, for a specified sum, a certain

number of young mechanics as apprentices. The scholars should pay this sum to the school and the school to the factory. Those of the best scholars who have no means should receive assistance, the school paying for them out of its own funds. We are convinced that the best factories would consider this an honor, and that this branch of manufactures in Austria would thus be so raised, that in twenty years all such aid would be unnecessary. This plan has been tried in Hanover, and in a very short time obtained the best results. Naturally, we hold the establishment of a small work-shop, with an experienced superintendent at its head, as very desirable for every polytechnic school. The chief aim of such work-shops should be to keep in repair the models it already possesses, to invent new according to the directions of the teachers, and to reserve a few places for such scholars for whom it had previously been impossible to visit a machine-shop in order to instruct such in the more common practical parts of working in metals, and to prepare them to attend a larger work-shop. A small number of places would answer for a large number of scholars by letting them take turns, and great care is to be taken that this instruction be kept in the background, and at the same time that it do not degenerate into a mere pastime.

## BUILDING AND ARCHITECTURE.

SCHOOLS.	LECTURES.		DESIGN.		Teachers.
	Terms.	Hours.	Terms.	Hours.	
Zurich, - - - - -	5	14	9	40	4
Carlsruhe, - - - - -	10	25	8	41	4
Stuttgart, - - - - -	7	21	8	40	4
Munich, (Engineers' School,)	6	8	3	30	3
Dresden, - - - - -	3	6	3	18	2
Hanover, - - - - -	6	21	8	52	3
Paris, (Central School,) -	1	2	1	..	1
Ghent, (Civil Engineering,)	3	6	2	..	2
Prague, (old plan,) - - -	1	5	1	5	1
" (new plan,) - - - - -	7	20	8	43	3

From this table we see that the greatest number of courses and lectures on this subject are given in the school at Carlsruhe. As for the lessons of design, we must remark that here in mechanics, as well as in the making of bridges and roads, the number of hours given in the plan is only the minimum. In reality, the industrious student must, in order to satisfy his teacher, devote much more time to construction and designing. The chief difference between the Austrian and other schools is, that in ours the constructive part (chiefly at least) is taught, while the architectural part is left in the hands of the art academics, (not to be confused, however, with special schools, like that of the Berlin Building Academy,) while in all the foreign schools, with exception of the Parisian, several terms are devoted to this; sometimes, also several teachers demanded. And, indeed, one cannot understand why it should not be possible to give a thorough education to architects of the highest grade at our polytechnic schools. The building of houses is indeed a branch in itself, and the desire to separate the practical from the esthetical part of planning a building, and to establish different schools for each, seems to us unnecessary, and moreover, directly opposed to a harmonious union of both aims. Besides this, the pupils after leaving the school will be much governed in their future course by inclination. If one, however,



grants to the polytechnic school the right of educating professional architects, one should not take from it the right to form the taste of the pupils, and their appreciation of the beautiful, at least as much as is now done in the Austrian schools, for under present arrangements, the pupil would find it much more useful to travel for one year, than to spend three there.

For this reason, we find lectures on building materials and building, as well as those upon style, history of architecture, &c., given in great numbers at foreign schools, as is also intended by the new plan at Prague.

In the best schools, the demands upon the scholar in the highest course (last term) are very great. We have had opportunity to see in Karlsruhe and Zurich great and detailed designs, made by scholars, of which many skilled architects need not have been ashamed. There is difference of opinion, as to whether at Karlsruhe and Zurich there should be one general course of study for all the scholars, or whether one should adapt the studies to each individual scholar, as at other schools. Those persons who superintend special schools are really the only ones who should decide here.

In all schools, for the purpose of illustrating the courses, models in wood, clay, and plaster of Paris, are furnished. We do not contradict ourselves in the opinion given in the previous article, by recommending the establishing of such workshops as these everywhere. Their cost is not great, the interest of the pupils is kept awake, and leads soon to the wished-for result; a thing not always to be affirmed of the machine shops. The reparation of wood models, the modeling of ornaments in clay, stone, and the forming of objects from drawings, are excellent exercises for the pupil. That here too, a previous practical experience is very useful, and in many schools is understood to precede these, we do not need to state. Excursions to interesting buildings in process of construction, accompanied by the professor, are at all times to be recommended.

CONSTRUCTION OF ROADS AND BRIDGES.

SCHOOLS.	LECTURES.		DESIGNS.		Teachers.
	Terms.	Hours.	Terms.	Hours.	
Zurich, - - - -	2	12	2	12	2
Carlsruhe, - - - -	4	20	4	20	2
Stuttgart, - - - -	2	14	2	14	1
Munich, - - - -	2	12	2	12	2
Dresden, - - - -	1	12	1	12	1
Hanover, - - - -	2	16	2	16	2
Paris, (Roads and Bridges,)	6	12	3	..	6
Ghent, (Civil Engineering,)	3	9	3	..	2
Prague, (old plan,) - - -	1	5	1	5	1
" (new plan,) - - -	3	12	4	27	2

This subject is, without question, best provided for, as the table shows, in the school *des ponts et chaussées* in Paris, which school is entirely devoted to this branch. We should also remark that one or two courses and one teacher might in this table be added to the German schools. We have already mentioned them in the article on building. They comprise instruction on building materials, and carpentry and masonry, but belong equally to the construction of streets and bridges. That which has been said in the previous article about workshops for

modeling in wood, clay, and plaster of Paris, applies perfectly to this subject. It is acknowledged in all schools that pupils in this branch need the most thorough and exhaustive mathematical instruction, as well as that instruction on machines, at least belongs to the preparatory course. On the other hand they are, in general, excused from the greater part of the architectural branches. We have already given the programme of instruction in Carlsruhe and at Paris. It only remains for us to express the wish that the professors of the technical schools should join with those of the building and railway department, in order that the students in this branch may have the opportunity of prolonged practice, for the simple visiting of a building in process of construction with the professors, as is the custom in many schools, cannot suffice.

## CHEMISTRY AND CHEMICAL TECHNOLOGY.

SCHOOLS.	Terms.	Hours.	Teachers.
Zurich, - - - - -	10	22	3
Carlsruhe, - - - - -	7	14	3
Stuttgart, - - - - -	6	19	2
Dresden, - - - - -	5	10	3
Berlin, - - - - -	9	20	5
Hanover, - - - - -	3	13	2
Paris, (Central School,) - - - - -	5	13	5
Liege, (School of Arts,) - - - - -	5	20	4
Prague, (old plan,) - - - - -	6	11½	1
" (new plan,) - - - - -	7	22	2

The practical exercises of the scholars in the chemical laboratory are not given here, since in most schools no regular time, but often a whole day, on which the lectures are suspended, is devoted to them. There is only a very small difference in this respect between foreign schools and ours. Everywhere there is the same division into general, analytical, and special chemistry, which latter division has, in general, four or five subdivisions. It is to be wished, first, that the laboratories were at least twice as large, in order to satisfy present needs, and to accommodate all capable scholars with practical work; in the second place, that the laboratories were better endowed and arranged, since they are very poorly furnished, that of Vienna excepted; and thirdly, that there might be more teachers, in order to take up the subjects more in detail. The school course of Zurich, Carlsruhe, and the Central School at Paris, show the division of instruction, and at the last school the comprehensive analytical method of treating the most important inorganic and organic compounds is especially interesting. The schools of Zurich and Carlsruhe have perhaps the best laboratories; those of Stuttgart, Berlin, Hanover, and Dresden are good.

## BOARD OF TEACHERS AND DIRECTION OF POLYTECHNIC SCHOOLS.

We have already remarked that the proper organization of a technical institution is very essential to its success. Even more important is the method of teaching, for it is possible that a school under the old system of things might accomplish much, if possessing some superior professors; but it is completely impossible that a school should answer the wants of the age, if it possesses inferior teachers, even though it have the best possible organization.

It is thus a natural question, in what way and by what means a school is to obtain a superior class of instructors? Before answering that question, we must



mention another important point connected with this. In most schools the chief professors form a corps of instructors, the faculty, which has certain rights, and upon which falls directly the discipline and direction of the school, Berlin being the only exception. The present arrangement at the Austrian Universities, which is projected in Prague, is convenient, namely, that the assistant teachers, tutors, resident graduates, &c., vote certain ones among their number into the faculty. The system of tutors is indeed as yet allowed only in the polytechnic school at Zurich, but we cannot see why this plan should not work as well elsewhere. In the Austrian schools there is more liberality.

At the head of the faculty, and hence of the school, in all schools is a director (president). He is either chosen yearly and approved by government, or is appointed directly by government, as at Dresden, Berlin, Hanover, and of course at Paris also. This circumstance, the yearly choice of a director or his appointment by government, is of great importance for the progress of each school, for it is sure that in the first case this, as well as the direct guidance of the school, is in the hands of the faculty, while in the second case, whatever rights may be granted the faculty, they are really vested in the hands of the director. It is rather a delicate point for us to endeavor to express the different views held in Germany on this subject, since, however much we may guard against it, we may be accused of seeking our own interests. Notwithstanding, we hold it for our duty, here where a principle is in question, and where we are not sure that any one director will agree with us, to pronounce our opinion, that under the present circumstances in the higher technical institutions, we would much prefer the periodical choice of a director (we state no term of service), and that by choice of the faculty. The most weighty arguments against the choice are the greater authority of a constant director, his influence upon the instruction that it may be well-ordered, the more severe discipline which he could enforce, the avoiding of quarrels and jealousies among the professors, as is the case at a yearly choice. These advantages have not always been obtained, for the authority of the (public school) teachers from among whom the director should be chosen, rests only upon their ability and success. Careless teachers would certainly be corrected sooner by the general disapproval of the faculty, than by the director alone, for in quiet times good discipline depends upon the individual teachers, and in disturbed years severe discipline can be carried out least of all by a director who does not always possess the confidence and support of the faculty. Certainly any of us, who has lived the last twenty years, can cite examples of this. Finally, there are parties in every corporation, to avoid which, one must have no faculty at all.

On the other hand, a yearly choice has the advantage, that only a very worthy member of the faculty will be chosen. This director, clothed with the whole moral power of his brother professors, the man in whom they place full confidence, has thus great influence on the students. The faculty will choose only such a man as will work energetically to further the interests of the school, and who will not pursue his own department of science to its injury.

In places where the director is chosen yearly, the practical instruction must naturally be separated from the scientific, and be entrusted to a teacher or other officer. In the universities this method has so far succeeded admirably.

But certainly the worst method is that adopted in some of our neighbor States, where the direction of technical institutions has been put in the hands, not of former teachers, but of officers of the ministerial department, and no influence at all, in the direction of the school, granted to the faculty.

If we come now to the rights of the faculty, the one above-named is certainly the most important, namely, the choice of a director, since the whole tone of the institution, and its attitude towards the world, depends directly upon this, and in this way is directly countenanced by the faculty. The other most important rights are those of discipline, which all faculties possess, that of making suggestions as to endowments and stipends, as well as suggesting reforms of individual branches of instruction, which right appertains to most faculties in Germany, but those of France do not possess it. Finally, the right of making suggestions when a vacancy in the faculty is to be filled. This is a privilege which only the Austrian schools enjoy, but one to be wished most heartily to others. The objection has been raised that in such case, out of desire to aid friends, quite other than pure scientific merit may procure the appointment, and this objection is not wholly without grounds. It would, however, never be dangerous, since the faculty has only the right of proposing two or three candidates, not of appointing them, this right remaining in the hands of the supreme authority under which the school stands. We could, however, wish that the faculty might possess more rights than are commonly possessed by it; and thus we come again to the question with which we started in this article, namely, how a technical institution may secure for itself and maintain a thorough system of instruction?

In the German schools it is not a matter of so great importance that the faculty has no influence over the filling of vacancies in the school, since it has always been a point of honor in the middle and smaller States to obtain the greatest possible reputation for their own university and polytechnic school. We have seen how even ministers of state have not scorned to make a journey and to negotiate personally with the persons devoted to this or that science. In Austria this is quite different, for by the system of salaries, a kind of regular advancement takes place when vacancies occur, so that worthy scientific men have no hope of rising through their talents. In Prague the salaries have been very considerably reduced since 1806. In many institutions of Austria they are less than are given to an overseer in a factory. How can we demand men to give a young man the education of an engineer, or of a superintendent of a factory, for the purpose of teaching, when he can at once get three times as large a salary in the workshop as in the school. Notwithstanding we hear complaints that so few talented men engaged in industrial pursuits, and devote themselves to technical instruction, while the very best teachers in the technical schools in Germany, as Karmaroch in Hanover, Redtenbacher (now dead) in Carlsruhe, Schneider in Dresden, &c., are Austrians who have deserted their own country because it offers them no situation befitting their talents.

Wherever the school is divided according to the different branches, as at Zurich, Carlsruhe, and Stuttgart, frequent meetings are everywhere held by their professors, who watch over the progress of instruction at the special schools; and choose from their own number a president of these meetings.

In the French schools, as well as at Zurich, Berlin, and Hanover, a special committee is appointed to watch over the progress of the school. This committee consists of a director and two or three professors, besides several distinguished scientific and business men, and the higher ministerial authority. These are appointed by government, which then makes directly on it all calls for advancement in instruction, and for filling vacant professorships. It is evident that this superintendence of government must be granted in concurrence with the professors and the director.



## CONDITION OF THE SCHOLARS AT POLYTECHNIC SCHOOLS.

The division of the pupils, the method of admission, fees of tuition, discipline and examinations are to be considered under this head.

In almost all the schools of Germany and Switzerland there are two classes of scholars. One of them, which is the principal one everywhere, has the name scholar or student, (in Austria, *audienee*); the second category has in Zurich and Hanover, the name "hearers;" in Carlsruhe and Dresden, "transient auditors" (*hospes*); in Stuttgart, and also in Austria, "special hearers or scholars."

The first class bind themselves to go through the whole course, prove their preparation on entering, and conform to the customary reviews, examinations, and written work. The latter class are not bound to any of these things. They are men in an independent position, or with regular employments, hearing only certain lectures without being obliged to pass an examination on them. In the French schools, in that of bridges and highways, as well as in the mining school, there are also two divisions, the *élèves ingénieurs* and the *élèves externes*, but the only difference here is that the first are graduates of the polytechnic school, who have to submit to no entrance examination, and who will be received into the service of the state, while the second class have none of these privileges, and must go through the whole course. In the Central School at Paris, and at the Belgian schools, there is only one class of pupils.

At all the polytechnic schools it is required that the pupils shall be of a certain age on entering; at Zurich and Berlin, 17 years old; at Stuttgart, Dresden, and Hanover, 16; the Paris schools alone demand no particular age. Further, an examination is required in all schools on entering; but in Berlin and Dresden the certificate of a gymnasium or of an industrial school is accepted. At all these examinations, mathematics and designing are the principal requirements, but some knowledge of physics, natural history, and style, is required. These examinations are most severe in France, where a list of questions is made out for every subject, and an examining committee are appointed who are exceedingly conscientious in their duties. In the German schools these examinations, from the desire to fill up the schools, are unfortunately not as severe as they should be for the good of the schools. The introduction of such examinations would be of great advantage to the schools of Vienna and Prague, since this would bring all the scholars, so differently prepared at different schools, up to one level, leave the poorer scholars to the industrial schools, and picking out only the best, would at once reduce the number, and bring together a more intelligent and energetic class of students.

The tuition varies exceedingly at the different polytechnic schools. The smallest tuition fee is that paid at Stuttgart, 15 florins; next year this is to be doubled. Then follows Zurich, 50 francs; this also is to be doubled; then Hanover, from 24 to 36 thalers; Berlin and Dresden, 40 thalers; in Dresden, for natives only, foreigners pay 60; and finally, Carlsruhe, 66 florins. The most expensive school is the *école centrale* of Paris, where the annual tuition is 800 francs. In all these schools, practice in the chemical laboratories is extra; in Zurich, it is 40 francs; in Carlsruhe, 44 florins; in Berlin, 50 thalers. In almost all schools, industrious and poor scholars are released from these expenses, but this for only a few at a time; for instance, in Hanover, generally only 4 or 5 per cent.; in Zurich, 6; in Carlsruhe, 10; in Dresden, at the most, 20 per cent. We are pleased with the two conditions, high tuition fees and few exceptions to

their payment. In the higher institutions of learning, the tuition should not be merely nominal, even though the State itself be bound to render assistance to the institution. Rather help the poor student with stipends sufficient to obtain him his daily bread, and to permit him to devote himself exclusively to his studies. This is the method at the industrial institute at Berlin, and at both the polytechnic and the central school of Paris. The tuition fees in all the polytechnic schools come into the school fund, with the one exception of Zurich, where two-thirds of it is divided among the professors.

In order to give a fair judgment upon the discipline of all the schools, it would be necessary to make quite a stay at each, since the practice is generally milder than the rule would indicate. The French schools are certainly the most severe, confinement (*carcer*) being among their punishments. For the rest, in some German schools, as at Dresden and Carlsruhe, conduct while out of the school is watched, and irregularities censured, but in most schools, conduct during session hours alone is regarded, and whatever misdeeds occur out of these hours are left to the police. In Stuttgart the pupils of the mathematical department are subject to severer discipline than those of the special departments. On the other hand, in Berlin, where a few years ago such extremely severe discipline was practiced, they are fallen now into the opposite extreme.

In our opinion, severe discipline is of little avail. This is proved in the Parisian schools. If the students are intelligent and ambitious, the discipline will be good without rules. Whenever admission examinations are demanded, a sure means of discipline is secured. A second means seems to lie in the hands of the individual teachers, who by frequent association with the students, will inspire them with zeal, and awaken intellectual activity within them. Should there, notwithstanding, be some unruly spirits, a fifteen years' experience has proved to us that in most cases, a careful examination by the faculty will accomplish much more than severe military rules.

The greatest difference between the Austrian schools and those of other countries we find to consist in the way in which the progress and industry of the scholars are judged. In the French and Belgian schools, even when the student does not board in the school, he is required to pass his time there from eight in the morning to six in the evening, one hour only being taken out for dinner. The lectures themselves occupy little time; during the greater part of it, the scholar must occupy himself with his studies in the school-room, where he is under the constant surveillance of the repeaters (*répétiteurs*). In Germany this surveillance is not so severe; home study is more recommended to the scholar. In other schools more time is given to repetitions and to written work than in Austria, for these alone determine the ability and knowledge of the student, and that much more surely than the final examinations in the latter country, to which all students, who desire a certificate at the end of the year, have to subject themselves. That these final examinations are in reality no sure proof of the industry and ability of the student, all Austrian technical teachers are agreed, but also they agree as fully that in those of our technical institutions, which like Vienna and Prague, are so overfilled, so long as this lasts, without at least the doubling of the number of teachers, the abolition of the final examinations and the introduction of the other method is a pure impossibility. In Germany, the ratio of teachers to scholars is 1 : 8 to 1 : 18; in Prague and Vienna, 1 : 25 and 1 : 30, and in some years even greater.



## SPECIAL INSTRUCTION IN AGRICULTURE AND RURAL AFFAIRS.

There are three kinds of institutions designed to give special instruction in agriculture and kindred industries, viz: 1. Schools of Agriculture, which are of three grades; 2. Schools of Forestry, which are likewise classified into superior, middle, and lower grades; 3. Veterinary Schools, of which there are 6 with 21 professors, and 391 pupils.

## I. SPECIAL SCHOOLS OF AGRICULTURE.

The Special Schools of Agriculture, of which there are seventeen, may be classed as follows:

1. The superior agricultural schools of Austria are among the oldest and best in Europe, that at Krumman in Bohemia, having been founded in 1799, and that at Graetz, Trieste, Lomberg, and Trutsch, in 1809.

The school at Graetz has nine professors, a model farm, a botanicaal garden, rich collections in natural history, and an establishment for silk worms.

The superior school at Krumman in Bohemia, founded by Princee Schwartzberg in 1799, is located on an immense domain, and is conducted with every appliance of botanicaal gardens, model farms, stock, illustrative collections of implements and machines, laboratories, herbarium, and numerous and able professors.

The superior school or academy at Altenburg in Hungary, provides for the complete study of agricultural science. It has nine professors and 147 pupils. The school fee is 63 florins; the total yearly cost 19,400 florins. It is a government establishment, possessing collections of all kinds, a chemical laboratory, a technological gallery, a library, and a botanicaal garden. It gives instruction in arboriculture and in rural and forest management. The exhibition of samples of the grain cultivated, and models of the implements used on the model farm, of the insects and animals which injure the plants, the herbals and soils, the copy-books, and drawings by the students, exhibited at Paris Exhibition of 1867, received the special notice and award of the jury.

2. Middle agricultural schools have been founded at Grossau, in Lower Austria; at Teschen-Liebwerd, in Bohemia; at Kreutz, in Croatia, and at Dublany, in Gallicia. The studies occupy two years. There are 27 professors; and 164 outdoor pupils. The school fee is from 30 to 52 florins. The yearly expenditure amounts to 9,200 florins. They are maintained by local resources and agricultural societies.

3. There are seven lower agricultural schools: at Grossau, in Lower Austria; at Liebejei-Rabin; at Teschen-Liebwerd, in Bohemia; at Gratz, in Styria; at Kreutz, in Gallicia; at Ezernichow, in Gallicia; and at Laybach, in Carinthia. These schools have 23 professors and 230 pupils. The school fee varies from 30 to 40 florins, partly met by the work of the pupils.

4. Besides the above, there are several schools devoted to special departments of rural economy, such as raising of bees, &c., as well as chairs of agriculture in 13 higher literary institutions.

## II. SPECIAL SCHOOLS OF FORESTRY.

The Schools of Forestry, (9, with 36 professors,) are classified as follows:

1. Superior forest academies are established at Mariabrunn in Lower Austria, and at Schemnitz in Hungary. The studies extend over from two to three years. The qualification for admission is a certificate of studies from a gymna-

sium or a superior practical school. These establishments have a museum, collections, a botanical garden, and a laboratory. They have 14 professors and 160 pupils in the two together. The school fee is 10 florins. There are some gratuitous pupils. Both schools are maintained by the government.

2. The middle forest schools are situated at Wissewasser, in Bohemia; at Aussen, in Moravia; at Kreutz, in Croatia. The studies occupy from two to three years. The primary school preparation only is required. These schools have 12 professors and 100 pupils. The gratuitous admission is compensated by the work of the pupils.

3. At Pibram, in Bohemia; at Windschaecht, in Hungary; and at Nagnay, in Transylvania, there are lower Forest Schools. The courses extend over two or three years. The preparation required is the primary school and the habit of working. There are eight professors and eighty-seven pupils, all gratuitous. These establishments are maintained by the State.

#### IMPERIAL FOREST ACADEMY AT MARIABRUNN.

The Imperial Forest Academy at Mariabrunn passed through various phases before it was reorganized in 1866. Formerly the Minister of Finance had the general superintendence, but at present it is assigned to the Minister of Commerce and Political Economy. Its aim is to impart a thorough theoretical and practical instruction in forest economy, for which purpose the large imperial forests in the neighborhood are placed at its disposal. The course is of three years duration, and consists partly of class lectures, and partly of scientific excursions and studies in the surrounding forests.

The students are either regular, who go through the complete course, or extraordinary, who take only a partial course. Students are admitted on presentation of a testimonial certificate of satisfactory scholarship in a real school or gymnasium; if from the latter, they must give additional evidence of proficiency in geometrical drawing. Since "maturity examinations" have not been generally introduced in the real schools, those students who cannot present a testimonial, have to undergo an examination extending over all those subjects which are required for admission at the polytechnic institute in Vienna. As a general rule all candidates must give proof that for one year they have been engaged in practical forest economy. To be admitted as an extraordinary student, the candidate must have completed the 18th year of his age, and be sufficiently versed in the preliminary studies.

Formerly students were obliged to live in the academy buildings, which condition has been lately abolished. Ordinary students, who have gone through the complete course of instruction, may be admitted to a rigorous examination, (for a diploma,) the conditions of which are prescribed by an imperial resolution of January 16th, 1850. This examination is held by a special examination committee, and consists of two divisions: First, mathematics, geodesy, forest surveying, mechanics, construction of machinery, architecture, chemistry, forest botany, geology, climatology, forest entomology. Second, forest economy in all its various branches. This examination is both written and oral.

The director of the academy is chosen by the ministry, who at the same time has the functions of a professor, and is assisted by four professors and three assistants.

The salary of the director is 3,000 florins; that of the professors, 1,500; 2,000 after ten years' service, and 2,500 after twenty years. The assistants' salary is 500 florins. The director, professors, and assistants live rent free in the academy buildings.



## ACADEMIES AND CLASSES FOR COMMERCIAL INSTRUCTION.

We find in Austria the earliest efforts to adapt schools and instruction to the needs of a commercial career. The plan drawn up by Wolf of Baden, and approved by the Empress Maria Theresa, (who had authorized instruction in book-keeping in the Piarist schools in 1763,) for a Commercial Academy in Vienna in 1770, was intended "to offer to young men who intend to devote themselves to commercial pursuits, a fundamental knowledge of all that distinguishes a skilful commercial man from a shop-keeper." The number of pupils was limited to sixty, and the course embraced, besides other studies, the German, French, and Italian languages, general and commercial geography, commercial and maritime law, book-keeping, and drawing. In 1799, the plan of this academy was remodeled, and again in 1808, making the studies more scientific, as well as more practical. On the model of this school, institutions were founded at Brunn in 1811, at Brody in 1815, and at Lemberg in 1817, and a commercial class, in the same year, was added to the navigation school at Trieste. In all the modifications of the real schools, the commercial classes have been provided for.

## ACADEMY OF COMMERCE AT VIENNA.

1. In 1857, the Academy of Commerce at Vienna was founded for young men intending to follow commercial pursuits. A capital of 400,000 florins was subscribed, and suitable premises built for the purpose. The school is provided with technological collections, a museum of natural productions, and complete chemical laboratories. A committee composed of nine members presides over the general management. The instruction is given in two divisions, one of them preparatory, requiring two years' study, the other technical, occupying the same length of time. The number of hours per week devoted to the different branches of instruction is shown in the following table :

PREPARATORY DIVISION.				TECHNICAL DIVISION.			
SUBJECTS TAUGHT.	No. of hours.		Totals.	SUBJECTS TAUGHT.	No. of hours.		Totals.
	1st year.	2d year.			1st year.	2d year.	
Religion, - - -	2	2	4	Commercial calculations, -	3	3	6
German, - - -	4	3	7	Book-keeping, - - -	2	-	2
Arithmetic, - -	5	4	9	Commercial correspondence,	3	-	3
Geography, - -	4	3	7	Political economy, - - -	3	3	6
History, - - -	3	3	6	Commercial law and exchanges,	-	-	-
Natural history,	4	2	6	Geography, commercial and	-	-	-
Calligraphy, - -	2	4	6	statistical, - - -	2	2	4
Book-keeping,	-	2	2	Commercial history, - - -	3	2	5
Physics, - - -	-	2	2	Chemistry, - - - - -	3	2	5
				Physics, - - - - -	2	-	2
				Study of merchandise and tech-			
				nology, - - - - -	3	4	7
				Austrian commerce and manu-			
				factures, - - - - -	-	-	-
				Model counting-house, - -	-	8	8
Totals, - - -	24	25	-	Totals, - - - - -	24	24	-

Besides this compulsory curriculum there are French, English, and Italian classes, one or other of which every pupil must attend, or two, or all, if he pleases. There are excellent laboratories for those pupils who wish to learn how to analyze different kinds of merchandise. This study is altogether op-

tional. In winter, qualitative analysis is taught, and quantitative in summer. The school fee is 157 florins, 50 kr. a year for all the courses.

Into the first class of the academy are admitted: those youths who have satisfactorily finished a higher real school, or higher gymnasium, or the preparatory class of some commercial academy; furthermore, those who in a rigorous examination for admission give satisfactory evidence of possessing the degree of general knowledge acquired usually in the preparatory course of the academy. As a general rule, only such are admitted to this examination as have entered their 16th year. For entering the second class of the academy, it is necessary either to have gone through the first class, or pass a rigorous examination.

To the first year of the preparatory course are admitted: youths who have absolved a three years' class, lower real school or lower gymnasium; those who (wherever they may have received their previous instruction) by a rigorous examination show the degree of knowledge usually acquired at the schools.

To the second year of the preparatory course, those are admitted who have either gone through the first class of the same course, or (wherever they may have been educated) show that degree of knowledge which is necessary for understanding the subjects taught in the second class. Only such are admitted to an examination for this class as have entered the 15th year of their age. Every scholar is obliged to attend all the recitations marked obligatory in the plan of study. Extraordinary students are only admitted in the higher classes.

At the close of the courses there are examinations for those who please to present themselves, and certificates of capacity are given to all who pass satisfactorily. Among the optional branches of instruction are stenography, to which some importance is attached, and drawing, which is cultivated both artistically and for its commercial uses.

Besides the regular classes during the day, there are evening classes for persons already engaged in business. These are held from 7 to 9 o'clock from October till Easter, and are attended by about 250 persons who pay four florins for each course, with the exception of the living languages, which are only two florins, and stenography, fixed at one florin. The subjects taught in these classes are commercial arithmetic, book-keeping, commercial correspondence, the rules of commerce, and exchange, &c., the living languages, and stenography. The majority of the persons attending the evening classes present themselves for examination to obtain certificates.

#### ACADEMY OF COMMERCE AT PRAGUE.

2. The Academy of Commerce at Prague was founded in 1826. It has a three years' course, in addition to a certificate of studies completed in the trade school, or the real gymnasium. The French language is obligatory; English and Italian are optional studies. There were in 1867, 204 pupils.

#### ACADEMY OF COMMERCE AT PESTH.

3. The Academy of Commerce at Pesth was founded in 1859, by the Chamber of Commerce, and in 1867 had 136 pupils, distributed through a three years' course, which was founded on the basis of the studies of the real school completed. It employs 29 professors, a portion of whom are attached to other institutions of the city, giving special instruction in this academy.

The commercial academies at Graetz and at Reichenberg (Bohemia) has a similar organization.



## ACADEMIES OF THE FINE ARTS AND INSTRUCTION IN DRAWING AND MUSIC.

The following are the schools of art, as applied to painting, sculpture, engraving, and music, in Austria :

## ACADEMIES AND SCHOOLS OF ART.

1. The Imperial Academy of the Fine Arts in Vienna was founded by Joseph I, in 1704, and completed by Charles V, in 1726. It is a State institution, as a gallery, a body of artists, and a school of instruction in art having 11 professors and an average of over 200 pupils. It has a valuable collection of pictures, several of them by the first artists, such as Claude, Murillo, and Titian.

2. At Gratz, there is an Academy of Painting, maintained by the province, with 30 to 50 pupils.

3. At Prague, the Academy of Arts is maintained by the "Patriotic Society of the Friends of Art," with an average of 61 pupils.

4. The School of Fine Arts at Cracow is maintained in connection with the Technical Institute, with 5 professors and 24 pupils.

5 Drawing is taught as a regular and indispensable branch in all technical schools, and in fifty-two art schools so designated.

## INSTRUCTION IN MUSIC.

1. The Conservatory of Music at Vienna originated with an association, but receives an annual subsidy from the government. It has a six years' course; fees, 4 to 6 florins per month. It has a director, 20 professors, and an average of over 200 pupils of both sexes.

2. The Conservatory of Music at Prague is supported by the "Society for the Improvement of Music," with aid from the government. It has three departments: one for instrumental music, with a six years' course; one for singing, with a two years' course; and one for the opera, with a two or three years' course. The teaching is gratuitous for natives. There is a director, a sub-director, and 19 professors.

3. The fifty-two art schools mentioned above, are also schools of music. They are partly organized by associations, partly by professors, and number in all, 231 professors, and 3,973 pupils of both sexes.

## SPECIAL SCHOOLS FOR FEMALE EDUCATION.

There are several institutions of special and professional instruction for women, of which we give a brief notice.

1. There exists in Vienna an Institute, where the daughters of officers with limited means and large families are educated so as to be able to take situations as governesses in wealthy families:

The pupils are 78 in number, and the expense of the establishment is defrayed by the government and private benefactions.

Girls are admitted from six to eight years of age, and remain till they are 20. The pupils are distributed into four classes, and each class has two divisions.

The directress of the establishment has under her orders four sub-directresses, a mistress for needlework, and a mistress to teach housekeeping.

2. There are 8 schools for midwives: at Linz, Klagenfurt, Laybach, Trieste, Alle-Laste near Trent, Zara, Venice, Czernovicz. Instruction of the same kind is also given to women at the faculties of medicine and surgical establishments

A large number of apprentice-midwives receive considerable pecuniary assistance during their studies from the provinces and townships.

Candidates must be at least 24 years of age, and less than 50, must be able to read and write, be of good reputation, and of healthy constitution.

The course of instruction occupies, according to circumstances, four, five, or six months. It is both theoretical and practical, and is given by a professor of obstetrics, aided by a midwife and a nurse.

In most of the schools there are two promotions yearly. On leaving, the pupils have to undergo a severe examination, for which those who have the means pay a fee of 30 florins.

There are ten professors engaged in these schools, with a like number of midwives and nurses. The professor's salary is from 420 to 630 florins. More than 1,200 midwives are instructed every year in these establishments. The expenditure amounts to 9,815 florins.

#### INSTRUCTION IN MINES AND METALLURGY.

Austria was one of the earliest to establish courses of instruction in the sciences connected with the profitable exploration of mines, and the smelting of ores. The Academy at Schemnitz was founded in 1763, lectures having been given at even an earlier period to a class of men charged with the superintendence of the salt-works, mines, collieries, and furnaces belonging to the crown.

#### MINING ACADEMIES.

Mining academies exist at Schemnitz, in Hungary; at Leoben, in Styria; and at Pibram, in Croatia.

The courses last from two to four years. The qualification for admission is a certificate from a gymnasium or a higher practical school. There are 23 professors and 255 pupils. The school fee is 10 florins, and many pupils are admitted without payment. The total expense is 14,700 florins. These establishments are supported by the State.

In addition to these special schools of mining, the sciences which belong to the subject are thoroughly taught at the Polytechnic School, and illustrated in the collections of the Geological Institute, at Vienna.

#### MINING ACADEMY AT SCHEMNITZ.

The Mining Academy at Schemnitz was founded during the reign of Maria Theresa, to aid in the developing the mines adjacent to that town, and distributed through the surrounding district, and in training engineers and overseers of the imperial mines in other parts of the empire.

The institution is well endowed, and well equipped with a laboratory, and all the facilities of assaying and smelting. The course extends through three years. *First year.*—Geometry, algebra, trigonometry, and conic sections, physics, mechanics, crystallography, and drawing. *Second year.*—Chemistry, mineralogy, metallurgy, and geology. *Third year.*—Surveying, machinery, art of mining, with practical exercises, dressing of ores, smelting, construction of machines and buildings, mining accounts, &c. A *fourth year* is given to additional practical exercises.



## SPECIAL INSTRUCTION IN DUCHY OF BADEN.

### INTRODUCTION.

THE Grand Duchy of Baden had, in 1861, on a territory of 5,904 square miles, 1,369,291 inhabitants, of whom 896,683 were Catholics, 24,099 Jews, and the rest Protestants.

About two-thirds of the population are engaged in agriculture, and the industrial activity of the other third is turned to ribbons and cotton fabrics, clocks and fabrics of straw, toys and trinkets. There are over 300 large manufacturing establishments. The income for 1862 was 17,140,192 florins, (about \$7,000,000,) and the state budget for public instruction, in 1863, contains the following items :

	Florins
Popular schools, - - - - -	86,084
Normal schools, - - - - -	30,086
Special aid to teachers in primary schools, - - - - -	56,000
Higher burgher schools, - - - - -	31,000
Secondary schools, - - - - -	68,838
Teaching of gymnastics, - - - - -	8,250
Universities, - - - - -	178,087
Technical or professional schools, - - - - -	18,025
Cabinets of physics, collections of natural history, &c., at Carlsruhe, - - - - -	3,279
Aid to <i>savants</i> , artists, museums, &c., - - - - -	5,677
Total, - - - - -	485,326

The supervision of public instruction, and of all institutions of education aided out of the budget, belongs to the Ministry of the Interior, who acts through a Council of Education, which is composed of a member for each of the four circles, or districts, into which the kingdom is divided, and a representative of each of the highest authorities in the evangelical, Catholic, and Jewish church organizations.

The system of public schools\* embraces:

I. *Primary Schools*,—which, in Baden, are denominational in their local management, but which must be attended by all children over six and under fourteen years, unless excused. There were in 1866, 2,157 primary schools, of which 1,389 were Catholic, 740 Protestant, and 28 Jewish, with an aggregate attendance of 200,000

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\* See Report on National Education in Europe, Part I, *Germany*.

pupils. Every parish must provide in winter, in the primary school-house, for a class of girls in sewing, knitting, and other home-work, for one hour after the boys are dismissed. An evening class is maintained twice a week, for young persons (whose attendance is optional,) who have left school, for further instruction in penmanship, letter writing, and the elements of natural history, and the industries of the locality.\*

II. *Secondary Schools*,—including 28 burgher schools, (superior primary schools,) with 2,154 pupils; 5 high schools for girls, with 280 pupils; 3 pedagogiums, with 382 pupils in a course of 6 years; 8 lyceums, with 2,108 pupils in a course of 9 years; and 5 gymnasiums, with 652 pupils in a course of 8 years.

III. *Superior Schools, or Universities*, viz: One at Heidelberg, founded in 1386, with a faculty of theology, philosophy and philology, medicine, and law, and an aggregate of 752 students; 1 at Freiburg, founded in 1454, with a faculty of Catholic theology, law, medicine, and philosophy, and an aggregate of 356 students; 1 Catholic archiepiscopal seminary, with 35 students.

IV. *Special and Professional Schools*, viz: 3 primary normal schools, with 170 pupils; 3 superior normal schools, (connected with the pedagogiums,) with 50 pupils; 2 agricultural schools, with 80 pupils; 1 veterinary school, with 10 pupils; 2 military schools, (one a review school for staff officers,) with 60 pupils; 1 normal school for gymnastics, with 35 pupils; 1 school of the fine arts, with 35 pupils; 41 schools of arts and trades, with 4,803 pupils; 1 polytechnic school, with six sections, (1 for mechanics, 1 for engineers, 1 for builders, 1 for foresters, 1 for chemists, 1 for constructors of machines, 1 for post office and other public service,) and 589 pupils; 1 watchmaking school, with 80 pupils; 3 straw-plaiting schools, with 120 pupils; 1 workmen's society industrial school, with 80 pupils; 1 institution for deaf mutes, with 30 pupils; 1 institution for the blind, with 25 pupils.

V. *Associations for the Advancement of Literature, Science, and the Arts*.—Under this head there are: 1 museum of natural history; 1 gallery of paintings and statuary; 5 public libraries, with an aggregate of 200,000 volumes, &c., &c.

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\* By the law of 1864, the primary schools are divided into elementary and superior; the elementary are confined to the rural districts which can maintain only one teacher, and the minimum instruction fixed by law; the superior primary schools are taught by two or more teachers, each of whom must give thirty-two lessons a week. When a school exceeds sixty pupils, there must be three classes. The schools are to become less denominational, and each commune can elect its own committee, one of whom must be the teacher, and in the larger communes, a physician, as well as the pastor.



## SPECIAL SCHOOLS AND INSTRUCTION.

Out of the many excellent institutions for special instruction in the Grand Duchy of Baden, we select for particular description, two which have attained great reputation.\*

## POLYTECHNIC SCHOOL AT CARLSRUHE.

THE POLYTECHNIC SCHOOL of the Grand Duchy of Baden is located at Carlsruhe, the capital of the duchy, a city of 25,000 inhabitants in 1860. The germ existed in a school of engineering founded in 1814, which was expanded into a large scientific school in 1825, by Prof. Winter, under the encouragement and aid of the Grand Duke Louis, receiving a building, and a forest school in 1832, and a chemical, a machine construction, and a commercial department in 1836, and then attained, by steady growth, the proportions of the most complete polytechnic school in Germany. Without large or diversified industries in the city of its location, and with several competing institutions of the same character in close proximity, (Stuttgart, Darmstadt, and lately Zurich,) the number of scholars has steadily increased, and its range of instruction has kept pace with the demands of the age, because its managers have been successful in obtaining and retaining an able corps of professors, and have provided them with suitable class-rooms, lecture-halls, laboratories, workshops, and all the material aids of technical instruction.

## ORGANIZATION.

This establishment is a kind of technical university, which, in addition to scientific studies of a high order, comprises in its organization several special divisions. The first of these is devoted not merely to mathematical science, as its name would seem to indicate, but also to the general scientific knowledge necessary for the other technical divisions, and which the pupils may acquire by following the particular courses relating to those sciences. This institution was the first of its class to introduce the system of independent schools, or divisions in the several great departments of industry, founded on a common scientific basis.

The technical divisions, or schools, are :

Engineers,	-	-	-	-	-	requiring 2 or 2½ years.
Architects,	{	Builders,	-	-	-	“ 2 “
		Architects,	-	-	-	“ 4 “
Foresters,	-	-	-	-	-	“ 2 “
Chemists,	-	-	-	-	-	“ 2 “
Constructors of machines,	-	-	-	-	-	“ 2 “
Commerce,	-	-	-	-	-	“ 1 “
Posts,	-	-	-	-	-	“ 1 “

The only qualification for admission is that the candidate shall possess the requisite instruction to enable him to follow one of the divisions. There is no absolutely compulsory series of study; the examinations alone impose on the pupils the necessity of acquiring the necessary instruction, and thus indicate to them the courses which are indispensable.

\* Compiled from Programmes of Institutions, Report of French Commission, and Report of Hamburgh Committee, and memoranda of a visit.

*Mathematical Division.*

The studies of this division extend over two years. For admission to the first year's course the candidate must be above 17 years of age, and must prove that he is sufficiently acquainted with elementary mathematics, and can treat of a given subject in the German language. A candidate may enter the second year's course at once on showing that he knows the subjects taught in the first year, and that he is 18 years of age. The following is the programme of studies:

	<u>Hours.</u>
<i>First Year :</i>	
Differential and integral calculus, - - - - -	5
Plane and spherical trigonometry, - - - - -	2
Analytical geometry of two dimensions, - - - - -	2
Descriptive geometry, - - - - -	6
Elements of mechanics, - - - - -	5
Experimental physics, - - - - -	4
(And one hour of repetition.)	
German language, - - - - -	2
French language, - - - - -	3
Free-hand drawing, - - - - -	2
Modeling, - - - - -	4
<i>Second Year :</i>	
Differential and integral calculus, - - - - -	4
Analytical geometry of three dimensions, - - - - -	2
Analytical mechanics, - - - - -	5
Descriptive geometry, - - - - -	4
Technical drawing, (summer,) - - - - -	4
Practical geometry, - - - - -	4
Higher physics, (winter,) - - - - -	3
Physical experiments, (summer,) - - - - -	6
General chemistry, (course of the chemical division,) - - - - -	4
Mineralogy and geology, - - - - -	3 to 4
German literature, - - - - -	2
French language, - - - - -	3
English language, - - - - -	3
Free-hand drawing, - - - - -	4
Modeling, - - - - -	4

*Division of Engineers.*

This division prepares for all the branches of the profession, military engineering excepted.

To be admitted, the candidate must possess the knowledge acquired in a gymnasium or lyceum as far as the second class, and that of the two years' mathematics of the preceding school. In the absence of certificates, the candidate must pass an examination.

The studies occupy two years, according to the following programme :

	<u>Hours.</u>
<i>First Year :</i>	
Calculation of variations, (winter,) - - - - -	2
Surveying, - - - - -	2
Method of least squares, - - - - -	1
Applied mechanics, - - - - -	3
Technological chemistry, - - - - -	3
Roads, hydraulic constructions, (with three afternoons of experiments,) - - - - -	5
Construction of machines, - - - - -	12
German literature, - - - - -	1



	Hours.
Ancient and mediæval literature, - - - -	5
Practical construction in wood and stone, - - - -	4 to 6
Free-hand and landscape drawing, - - - -	4
English language, - - - -	3

*Second Year :*

Bridges and roads, - - - -	6
Construction of railways, - - - -	2
Exercises in practical building every afternoon in winter, and both morning and afternoon in summer, - - - -	6
Construction of machines, - - - -	2
Questions in mathematical physics, (summer,) - - - -	2
Popular law, - - - -	5
German literature, - - - -	5
Ancient and mediæval history, - - - -	4
Free-hand and landscape drawing, - - - -	4

*Third Year :*

This course, which is one of six months only, is intended for engineers who intend to practice in the Grand Duchy. They have to familiarize themselves with the regulations and usages as to contracts for public works, as well as to price currents (two hours per week.)

	Hours.
Drawing up of projects, specifications, estimates, - - - -	8
Higher architecture, - - - -	3

The pupils are taken out for excursions to building yards and works in course of execution; in this case the lessons are interrupted.

*Division of Builders.*

This division is subdivided into two parts; the lower section is intended to train builders, (*werkmeister*), capable of projecting and executing all ordinary buildings for dwellings and manufacturing purposes. The higher division is meant to train architects in the higher sense of the word, and those who pass through it are expected to improve themselves subsequently by traveling to study the more remarkable creations of their art.

This division requires four years' study; the qualifications for admission are the same as for the engineering division, except that only the first year's course of the mathematical division is necessary.

	Hours in Winter.	Hours in Summer.
<i>First Year :</i>		
General and inorganic chemistry, (chemical course, 1st division,) - - - -	4	4
Mineralogy and geology, - - - -	3 to 4	3 to 4
Building materials, - - - -	2	2
Descriptive geometry, - - - -	4	4
Statics of buildings, - - - -	2	2
Architectural drawing from copies, - - - -	4	6
Drawing of plans, - - - -	4	6
Landscapes, - - - -	4	4
Drawing of ornaments, - - - -	4	6
Modeling in plaster, - - - -	4	-
Building arches in the yard, - - - -	-	4
Modeling in wood, - - - -	4	4
Ancient and mediæval history, - - - -	5	5
German literature, - - - -	1	1

	Hours in Winter.	Hours in Summer.
<i>Second Year.</i>		
Knowledge of machines, - - - - -	6	6
Bridges and roads, - - - - -	5	5
Technical architecture, - - - - -	4	4
Elementary studies of projects, - - - - -	2	2
Architectural drawing from models and copies, projects, - - - - -	4	6
Projects of dwelling houses, - - - - -	4	6
Landscape drawing, - - - - -	4	4
Drawing ornaments from copies, - - - - -	4	6
Modeling in plaster, - - - - -	4	-
Building arches in the yard, - - - - -	-	4
Modeling in wood, - - - - -	4	4
Ancient and mediæval history, - - - - -	-	-
Literature, - - - - -	-	-
<i>Third Year :</i>		
Technical course of architecture, 2d part, - - - - -	3	3
Higher art of building, - - - - -	3	3
History of ancient architecture, - - - - -	2	2
Plans of dwelling houses, - - - - -	6	9
Graphic studies on the more remarkable orders and edifices, - - - - -	2	3
Aerial perspective, - - - - -	2	3
Drawing ornaments from models and nature, - - - - -	3	3
Drawing of figures, - - - - -	4	4
Free-hand drawing, - - - - -	4	4
Modeling from models, - - - - -	5	4
Ancient and mediæval history, - - - - -	-	-
German literature, - - - - -	-	-
<i>Fourth Year :</i>		
Popular law, - - - - -	2	2
Higher art of building, - - - - -	3	3
History of mediæval and modern architecture, - - - - -	2	2
Projects of great public buildings, - - - - -	6	9
Study of the architecture of the middle ages, and copying of the principal monuments, - - - - -	2	3
Perspective views in water colors, - - - - -	2	3
Drawing of ornaments, - - - - -	2	3
Figure drawing from plaster models and nature, - - - - -	4	4
Free-hand drawing, - - - - -	4	4
Modeling from nature or fancy, - - - - -	5	4
Ancient and mediæval history, - - - - -	-	-
German literature, - - - - -	-	-

The mornings left free are devoted to graphic studies, and, at the end of the school year, there is a competition for the fourth class. A gold medal is given for the best project.

In these programmes for the architectural division, it is worthy of remark that there is no mention of mathematical instruction with regard to the stability of buildings, the strength of materials, &c. Such being the case, it is not easy to see the utility of the high mathematics and mechanical analysis required for admission into this division, the first two years of which are intended to form builders and overseers of works. It would, perhaps, be better to require less of the higher mathematics and more of the applications of the principles of science to the art of building. The practice of exercising the pupils of this division in the actual construction of various arches appears to be excellent. But as this



can only be done with bricks, it should not set aside that of making vaults and other constructions in plaster on a reduced scale, which oblige the pupils to trace all the panels and completely realize the different parts.

After the first two years' studies, the pupils who have no higher ambition than to become builders or overseers of works have acquired sufficient theoretical and practical instruction.

### *Division of Foresters.*

The instruction of this division consists of: 1. A preparatory course; 2. Two years' studies. To enter the preparatory course, the qualification required is proficiency in the subjects taught in a lyceum as far as the second class, or else in all the classes of a gymnasium. The following is the programme:

	Hours.
<i>Preparatory Course:</i>	
Arithmetic and algebra, - - - - -	3
Plane and solid geometry, - - - - -	3
Experimental physics, - - - - -	4
General and special botany, - - - - -	4
Zoology, - - - - -	3
Botanical excursions and observations once a week in summer.	
History of German literature, - - - - -	2
Popular law, - - - - -	2
Rudiments of forest science, - - - - -	2
Practical instruction in forest questions and in the accounts of forest administration, - - - - -	-
<i>First Year:</i>	
General arithmetic and algebra, - - - - -	2
Plane polygonometry, spherical trigonometry, - - - - -	2
Mathematical forest exercises, - - - - -	4
General chemistry, - - - - -	4
Mineralogy, (winter,) - - - - -	3
Geology, (summer,) - - - - -	4
Practical mineralogy, - - - - -	2
General botany, anatomy, chemistry, physiology, geography, (winter,) - - - - -	4
Climate, meteorology, knowledge of soils, - - - - -	3
Natural history of timber trees, - - - - -	2
Forest management, (winter,) - - - - -	3
Forest dues, - - - - -	2
Practical geometry, - - - - -	4
Excursions and explanations in the forest, - - - - -	-
Botanical excursions, - - - - -	-
<i>Second Year:</i>	
Solution of problems, - - - - -	2
Agricultural chemistry, - - - - -	2
Administrative science, political and financial economy, - - - - -	2
Roads and hydraulic constructions, (elements,) - - - - -	2
Guarding and protecting of forests, - - - - -	2
State of forest science, - - - - -	2
Working and valuations after rational methods, - - - - -	4
Valuation of the soil and produce of the forest as the basis of their real worth, - - - - -	2
Notions on the chase, - - - - -	2
Forest administration, - - - - -	2
Forest police, - - - - -	3
Forest laws and those of the chase, - - - - -	2
Excursions and journeys with applications.	

*Division of Chemists.*

This division is especially devoted to young men who purpose following careers in which a knowledge of chemistry, physics, and natural history may be useful, whether they intend to devote themselves to chemistry or to engage in mining or metallurgical works. Admission is free to all who possess the instruction necessary for following the courses, and are full 17 years of age. The subjects taught are summarily stated in the following programme :

	Hours.
General chemistry, 1st course, inorganic part, (winter term,) -	4
Organic chemistry, (summer term,) - - - - -	4
General chemistry, 2d course, history and philosophy of chemistry, (one year,) - - - - -	1
Repetition of chemistry, (winter,) - - - - -	2
Conference on chemical analysis, (summer,) - - - - -	2
Art of assaying metals, - - - - -	-
Manipulations in the laboratory, - - - - -	-
Qualitative and quantitative analysis, - - - - -	-
Agricultural chemistry, (winter,) - - - - -	2
Chemical technology, organic and inorganic, various manufactures, (one year,) - - - - -	3
Metallurgy, (one year,) - - - - -	2
Experimental physics, - - - - -	4
Repetitions of physics, - - - - -	1
Higher physics, - - - - -	-
Botany and geology, - - - - -	7
Mineralogy, (winter,) - - - - -	3
Physical geography, (summer,) - - - - -	4
Knowledge of useful minerals, (winter,) - - - - -	2
Practical mineralogy, excursions, &c., (summer,) - - - - -	2
Crystallography, (winter,) - - - - -	2

This very extensive curriculum constitutes a series of courses which may be followed, not only by the pupils more especially destined for the chemical arts, but also for those of the other divisions. To take part in the chemical manipulations, the pupils pay 44 florins a year, and are supplied with all the needful re-agents.

*Division of Constructors of Machines.*

The qualification for admission is the instruction acquired by a pupil during the first year of the mathematical division. The whole course takes two years. The number of hours per week devoted to each subject is indicated in the following programme :

<i>First Year:</i>	Hours.
On machines, - - - - -	6
Construction of machines, - - - - -	4
Arrangements of machines, - - - - -	6
Experimental physics, - - - - -	4
Applied mechanics, - - - - -	3
Practical geometry, - - - - -	-
Mechanical technology, - - - - -	2
Chemical technology, - - - - -	-
Metallurgy, - - - - -	-
Knowledge of useful minerals, - - - - -	2
Roads and hydraulic constructions, - - - - -	5
Free-hand drawing, - - - - -	4
Ancient and mediæval history, - - - - -	5
Practice in workshops from 4 to 6 p. m., - - - - -	-
German and French literature, - - - - -	4



<i>Second Year :</i>	<u>Hours.</u>
On machines, - - - - -	6
Construction of machines, - - - - -	4
Putting up machines, - - - - -	6
Mechanical technology, - - - - -	2
Select questions of mathematical physics, - - - - -	2
Higher physics, - - - - -	6
General chemistry, - - - - -	4
Id. repetitions, (winter,) - - - - -	2
Road and hydraulic constructions, - - - - -	6
Railways, (summer,) - - - - -	2
Chemical technology, - - - - -	-
Metallurgy, - - - - -	-
Ancient and mediæval history, - - - - -	-
German literature, - - - - -	-
Free-hand drawing - - - - -	4
English language, - - - - -	4
Practice in workshops from 4 to 6 p. m., - - - - -	-

#### *Commercial Division.*

The qualification for admission to this division is the instruction that can be acquired in an upper middle class school. The instruction is given according to the following programme :

	<u>Hours.</u>
On commerce, - - - - -	5
Book-keeping, - - - - -	2
Commercial correspondence, - - - - -	3
Commercial arithmetic, - - - - -	3
Knowledge of merchandise, - - - - -	3
Commercial geography, - - - - -	3
Commercial history, - - - - -	1
Languages. { German, - - - - -	4
{ French, - - - - -	4
{ English, - - - - -	3
Calligraphy, - - - - -	2
Drawing, - - - - -	2

#### *Post Office Division.*

The qualification for admission is the degree of instruction acquired on leaving the upper class of a gymnasium or the higher division of the fifth in a lyceum. Two years are required to complete the courses which are arranged as follows :

<i>First Year :</i>	<u>Hours.</u>
Arithmetic, - - - - -	3
Mechanics, - - - - -	3
Experimental physics, - - - - -	4
French language, - - - - -	4
German language, - - - - -	2
Calligraphy, - - - - -	2
 <i>Second Year :</i>	
Political arithmetic, - - - - -	3
Geography, - - - - -	2
General notions of political economy, (summer,) - - - - -	2
Popular law, - - - - -	2
Commercial law, - - - - -	3
Application of mechanics to conveyance, - - - - -	2

	Hours.
Ancient and mediæval history, - - - - -	5
German literature, - - - - -	2
French language, - - - - -	3
French literature, - - - - -	2
English language, - - - - -	3
Calligraphy, - - - - -	2

### *Management.*

The committee of management consists of a director, two councillors, the librarian, the secretary, and an accountant. The staff of teachers, professors, assistant professors, and masters is arranged as follows :

	Prof.	Assist.
Mathematics, - - - - -	4	2
Natural sciences, - - - - -	6	2
Architecture and building, - - - - -	4	1
Bridges and roads, - - - - -	3	-
Knowledge of machines, - - - - -	3	-
Forest sciences, - - - - -	3	-
Commerce, - - - - -	2	-

	Masters.
General courses, (languages and literature,) - - - - -	9
Sculpture, - - - - -	1
Calligraphy, - - - - -	1
Workshops, - - - - -	3

The professors are appointed and paid by the government. The director is elected for one year, by the heads of the several divisions.

The students are classified as regular or irregular. The latter are persons of ripe age, and generally graduates of other technical schools, and attend only special courses of lectures, by permission. The regular students must be members of some particular division, and pay an admission fee of \$3.00, and an annual tuition of 66 Rhenish florins. The tuition covers more than half the expenditures of the institution. The rest is paid by the government.

The discipline of the institution is strict, and the head of each department is charged with the supervision of his pupils.

The number of pupils, regular and irregular, in 1861, was 826, and the age ranges from 18 to 22 years.

### *Buildings and Material Equipments.*

The building, laboratories, and collections for illustrating the studies of the several divisions, are among the best in Europe. The main building is 406 feet (Bavarian) long, and 42 feet deep, with wings 100 feet long, by 40, in the rear. The laboratory of the chemical department is in a separate structure, (220 feet long, by 50 deep,) and will accommodate 100 students at their manipulations, with separate rooms for distillation, and other processes. There is a separate building, of the same size, for the lectures, models and designs for machines, in which the collections are very large and complete. The workshops, three in number, are not large, and the only one appropriated to students is not largely resorted to. The cost of the buildings was about \$250,000. The collections and instruments, for illustration in each division, are large and admirably selected, or constructed on the premises for use.



## TRADE SCHOOLS.

The object of the trade schools (*gewerbe schulen*), of Baden, as expressed in the words of the law, is "to afford to young persons who propose to follow a trade, or mechanic art, which requires no high grade of technical or scientific training, and who have already acquired a practical knowledge of its rudiments, such knowledge and skill as will make them capable of an intelligent pursuit of it."

The schools are open to apprentices, or those about to become apprentices, above the age of fourteen; to journeymen, of good character, possessing sufficient preparatory knowledge, and to any one who may wish to attend any single course.

Attendance upon them was, until recently, obligatory upon all apprentices, but the regulation was found to bring in pupils who felt no interest in the studies, and did not profit by the instruction, but disturbed those who were studious.

There were 4,920 pupils in all the schools, (forty-one in 1868,) of which about 500 were journeymen, and 800 pupils not yet connected with any trade.

The number of professors was, in 1862, thirty-four, with thirty-six assistants, and the total of their salaries was 30,533 florins of the Rhine. The expenses are defrayed in part by the state, in part by the parishes, and a small tuition fee is charged, which may be remitted, in case of inability to pay.

The school is held, during the winter, from seven to ten in the morning; during the summer, from six to nine, and on the afternoon of Sundays. The whole course lasts three years, and is preceded by a preparatory course. Pupils are not obliged to pursue those studies which have no reference to their future occupation.

The best of these schools, although not the one numbering the most pupils, is that at Baden-Baden. Its curriculum, which we take as an example, is as follows:

## TRADE SCHOOL AT BADEN.

*Commercial course*, 1st class, (1 hour per week,) keeping accounts, drawing up bills, letters of credit, bills of exchange, notes, receipts, &c.; 2d class, (1 hour,) certificates, forms conferring powers of attorney (*formules de pleins pouvoirs*), advertisements, letters of credit, &c.; 3d class, (1 hour,) bills of exchange, principal documents made valid by the mere signature of the individual putting them forth, (*principaux actes sous seing privé*), petitions to the government, commercial letters, &c.

*Course of arithmetic*, 1st class, (2 hours,) simple fractions and decimals, comparison of the weights and measures used in France and Baden, proportions, rule of three; 2d class, (1 hour,) review of what was taught the first class, rules of interest, alligation, partnership, extraction of square root; 3d class, (1 hour,) equations of the first degree and several unknown quantities, continuation of the rules of partnership and of interest, extraction of cube root.

*Course of geometry*, 1st class, (1 hour,) triangles, squares, and polygonal figures; 2d class, (1 hour,) mensuration of surfaces; 3d class, (1 hour,) mensuration of the volume and weight of regular bodies.

*Course of industrial economy*, 2d class, (1 hour,) connections between workman and employer; 3d class, (1 hour,) connections between employer, master workman, and workman.

*Course of book-keeping*, 3d class, (1 hour,) drawing up of inventories, transaction of fictitious business.

*Course of natural history and mechanics*, 2d class, (1 hour,) considerations upon the general qualities of bodies, centres of gravity, stability, parallelogram of forces; 3d class, (1 hour,) hydraulic press, pumps of various kinds, heat, and magnetism.

*Course of geometrical drawing*, includes a course of free-hand drawing and modeling.

*Course of free-hand drawing*, 1st class, (1 hour,) regular plane figures; 2d class, (1 hour,) regular solids; 3d class, (3 hours,) machines, plans, subjects, &c.

*Course of modeling*, the 3 classes, (4 hours,) turning, metal and wood work.

To the practical course are assigned five workshops, in which the pupils work from half past seven to nine. The number of pupils in this school is 200.

The other leading trade schools are at Constance, 233 pupils; Freiburg, 361; Karlsruhe, 304; Pforzheim, 483; Heidelberg, 424; and Mannheim, 282.

#### SCHOOL FOR WATCH AND CLOCKMAKING AT FURTWANGEN.

Since the sixteenth century the manufacture of clocks has been one of the staple trades of this part of Germany; and in 1847 it is estimated that there were more than 4,000 persons employed in watchmaking. In the year 1849 a special school for this branch of industry was established, and the place selected for its seat was Furtwangen, in the canton of Freiburg, the old centre of the clock manufacture in the Black Forest.

This school now comprises: 1. A general trade school (*Gewerbeschule*) teaching more especially everything connected with clockmaking. 2. A purely practical school, with workshops for improving workmen in the different branches of the art, and provided with everything required for promoting the progress of horological manufactures in Baden generally.

*Industrial School.*—The instruction given here consists of three courses, each occupying a year. The classes are always held in the morning, beginning at six o'clock in winter, and at five in summer, and vary from seven hours to fifteen and a half hours per week for each class of pupils. Moreover, seeing the general importance of free-hand drawing, three hours are devoted to it every Sunday for apprentices and workmen. The clockmaking school even supplies pupils of insufficient means with all the necessary material.

For children of either sex, between the ages of eight and fourteen, there are three courses of drawing. Instruction in modeling is given to joiners, sculptors, and painters, if they desire it. Besides, pupils are also taught moulding, the art of casting, of taking impressions on various materials, gilding on wood and stone, burnishing, varnishing, polishing, copper plate printing, &c.

In 1861 this school had 49 pupils and seven free auditors.

There are: 1. A principal professor of special drawing, of mechanics, of the knowledge of machines, of applied physics and chemistry. 2. A professor of free-hand drawing, of ornaments, modeling, and decoration. 3. An assistant master for German, arithmetic, geometry, geometrical constructions, and commercial accounts.

The instruction is thus distributed among the three classes:

	Hours.
<i>First Class:</i>	
Arithmetic and plane geometry, - - - - -	3
German language, - - - - -	2
Geometrical constructions; drawing applied to clockmaking, 2 to 3	2 to 3
Free-hand drawing, - - - - -	1 to 3
<i>Second Class:</i>	
Arithmetic and geometry, surfaces, volumes, curves, &c., -	2 to 3
German, contracts, commercial correspondence, -	2
Book-keeping, - - - - -	1
Applied mechanics and physics, power and work, centre of gravity, the pendulum, simple machines, lever, wedge, screw, pulley, - - - - -	2



	Hours.
Motions of clockwork, generalities on the measure of time, constituent parts, and their relations, - - -	1
Drawing geometrical constructions, penetrations, curves for the teeth of wheels, tools, - - -	2 to 3½
Free-hand drawing with the pencil, shading, - - -	1 to 3

*Third Class :*

Arithmetic and mechanics, problems in clockwork, transformation of movements, - - -	1 to 2
Motions of clockwork, calculation of wheels, the different kinds of clocks, the best escapements, tools, and machines, -	2
Applied physics, especially with relation to clockwork, -	1½
Special drawing for clockwork, - - -	4
Free-hand drawing, shading, - - -	1½

*Workshops for Improvement.*—There are at present three of these workshops, two for watches and one for clocks.

The first watch workshop admits young men who intend to follow the trade, and gives them all the means of becoming expert workmen. The second shop is a continuation of the first, that is to say, as soon as a young man has acquired in the first sufficient skill to take part in the manufacture of watches, he is at liberty either to enter any private manufactory or to pass into the second shop, where he continues to work under the direction of the professor, at the same time receiving wages. Skilful watchmakers are also received in this second shop to work by the piece. Both these shops are under the same roof as the school. The workshop for clocks is, on the contrary, owing to want of room, in the residence of the professor, and as he keeps a workshop of his own for clocks, the organization is analogous to the one we have described for watches. Every pupil has a place to himself like a workman; the tools are exactly the same as in a complete watch and clock manufactory, organized according to the best and most recent processes, and on the system of division of labor.

The workshops are never closed for want of work; but there are holidays at Easter, at the end of the school year, and in Carnival time, just the same as in the other manufactories of the Black Forest. The working hours are, in accordance with the general usages of the trade, from 7 to 11.30 a. m., and from 1 to 7 p. m., that is 10½ hours' work per day,—63 hours per week. Of those who attend the trade school, those in the first class have seven hours' instruction, and 58 of practice in the workshops, in all 65 hours in winter; those of the second class, 12 hours and 54 hours, or 66 hours in all; those of the third class, 7 hours and 58 hours, or 65 hours. In summer the theoretical courses begin at an earlier hour, which prolongs to 66 or 68 hours the time employed per week.

In the workshop for clocks the hours of work, according to the custom prevalent in the Black Forest, are 13 per day. In the second shop those who work by the piece can leave off at dusk.

There is no time fixed for pupils to remain in either workshop; their stay depends on the aptitude, application, and progress of each individual. In general the apprenticeship does not exceed three years. In the contract signed on entering, the pupil engages to pay a certain sum in case he leaves the school by his own desire, or if, on withdrawing from the watch workshop, he leaves the Black Forest. In all other cases the instruction is gratuitous.

Each of the two workshops has a bench for 10 pupils, the number of practical pupils, therefore, can not exceed 20.

*Workshops for Watches.*—The principle of division of labor is adopted in these shops, so that, as soon as a pupil possesses a general knowledge of the trade, he is advised to select the particular speciality for which he has most aptitude, or which best meets the actual wants of the establishment.

The instruction therefore consists: 1. Of a general part common to all the pupils. 2. Of a part special to each pupil, and which will render him perfectly competent to undertake one or more of the branches forming the complete manufacture. 3. Of a part intended to form workmen thoroughly versed in both the practice and the theory of the art.

The first, or general part, forms the basis of all the subsequent instruction, and is, therefore, of the utmost importance. While the pupils are going through it the professor has ample opportunities of appreciating their capabilities and of deciding what special branch will best suit them.

In this part of the course the pupil has to acquire,—dexterity in filing, turning, drilling, polishing, &c.; a knowledge of the treatment of materials, hardening and annealing of steel, hammer-hardening of brass, &c.; the power of making small tools, such as punches, drills, counter-sinks, rimers, screw-taps, &c.; the use of the simple machine tools; a facility of producing pieces in the rough, a knowledge of the constituent parts of a watch, the practice of drawing watches, and all their parts.

The details of the practical teaching are so numerous that it is impossible to give them here. Strict attention is paid to the perfection of the work, and to the exact proportions of size. The parts most minutely examined for the making of the pieces in the rough are the lever, escapements, the balances, the cutting and setting of the jewels the position of the wheels, &c. The instruction of the complete watchmaker embraces a knowledge of all parts of the divided labor; it must also familiarize the pupil with the geometrical proportions of the parts of a watch, enable him to judge of its movement, to undertake improvements, and even to devise new systems.

This instruction is given by a professor and his assistant, both practical watch-makers.

In the year 1860 there were 13 pupils, four of whom had completed the course at its close. In 1860–61 there were only 11 pupils, as none are admitted but those who display more than the average talent.

*Workshops for Clocks.*—The object of these is to improve this branch of manufactures in the Black Forest. Owing to the peculiar organization of the clock manufacture, it is very difficult to establish the principle of division of labor in this branch; the instruction given, therefore, is such as to enable every pupil to take any work that he can obtain in establishments already existing, or to set up a workshop of his own. It is indispensable that, while more especially cultivating the branch for which he feels most inclined, he must none the less learn to make complete movements, and to prepare the different pieces in the rough, otherwise he could not be of much use in the present manufactories of the Black Forest. It is nevertheless necessary for him to know the system of the division of labor, and the use of the more expensive and more perfect machines, so as to be able to take advantage of them whenever an opportunity occurs.

The instruction is divided into: 1. The general elementary teaching common to all the pupils; 2. The general improvement of the pupil in all the branches, but with a more particular study of that for which the pupil is best fitted.



The pupil has to acquire : Dexterity in filing, drilling, turning ; the knowledge of materials, and manner of treating them ; the making of the different tools ; instruction in the use of the various machines required in the manufacture of clocks ; the knowledge of the constituent parts of a clock, their purpose, and execution. The concluding instruction consists in teaching how to make the cases, barrels, and wheels ; the moving powers ; the conditions indispensable for good working of the wheels ; the making of ordinary movements ; striking and repeating clocks ; finishing with pieces in the rough. As there are always in the workshops pupils of various degrees of proficiency, this last course can not be divided into sections. The instruction is given by a professor.

The Furtwangen school has in all six professors, one of whom is director ; there are also two workmen and one man servant.

During the last year there were 80 pupils :

In the industrial school of the first year,	-	-	-	-	29	
“ “ second year,	-	-	-	-	11	
“ “ third year,	-	-	-	-	9	
In the workshops	{	for watches,	-	-	-	14
		for clocks,	-	-	-	17

Fifty-four boys, from 8 to 14 years of age, and 18 girls, from 8 to 13, have attended the school for free-hand drawing. The yearly sum allowed for the school by the government is at present 10,000 florins.

#### PLAITING SCHOOLS.

Another of the staple industries of the Black Forest is straw-plaiting, and this also has been encouraged by the opening of schools. In 1851 a school for girls was established at Furtwangen under an able mistress, and in this school skilful workers were trained who have since themselves become mistresses. Numerous other schools for straw-plaiting have been opened in the Black Forest.

#### SCHOOLS OF AGRICULTURE AND RURAL ECONOMY.

There is a school of agriculture at Hoehburg, with 21 pupils ; of arboriculture at Carlsruhe, for only eight or ten weeks, with 10 pupils ; of horticulture at Carlsruhe, with 13 pupils ; of grazing and meadow culture at Carlsruhe, with 16 pupils.

The agricultural school at Hoehburg was founded in 1848, on the national domain. Its course of instruction is ample, with 12 lessons a week in winter, and 17 in summer, and extends through three years. The practical instruction in the first year is devoted to ordinary farm labor ; in the second, to the care of animals generally ; and the third year in particular to horses. Instruction is gratuitous. Each pupil receives a gratuity of \$16, and regular wages for his work, amounting the first year to \$28 ; the second, to \$37 ; and the third, to \$46. The cost of board is about \$70 dollars a year.

The knowledge of agriculture is also propagated in the primary schools, the masters of which are bound to give lectures on the subject beyond the limits of elementary teaching, properly so called, especially to the improvement and evening classes. The central commission of agriculture sends competent persons to see that this instruction is properly given, and awards prizes to the masters who perform this part of their duty with distinguished ability.

For the diffusion of knowledge concerning agriculture there is, under the direction of the central commission of the Grand Duchy, an agricultural society

which extends its action over the whole country. At the end of 1862 this society numbered 11,934 members, and it publishes a weekly journal of agriculture which has a circulation of 9,000 copies.

#### MILITARY SCHOOLS.

In 1820, the Grand Duke Louis founded the School of Cadets for the education of young officers; but its existing organization dates only from 1851. Youths are admitted to this school from 15 to 18 years of age, after being recognized as fit for the military service, and having proved that they possess the requisite instruction, which comprises all that is taught in the gymnasia of the Grand Duchy as far as the fourth class inclusively.

The studies last three years, and embrace :

*Theoretical Course.*—German and French mathematics, the military code, tactics, the military art, fortification, history, geography, land-surveying.

*Practical Courses.*—Infantry and artillery exercises, manœuvres, and the use of arms, fortification, surveying, and reconnoitering.

*Gymnastics.*—Fencing and sword exercise; gymnastics, riding, swimming.

The number of cadets, in 1867, was 60.

There is likewise at Karlsruhe an improving school for superior officers.

#### SCHOOL OF GYMNASTICS.

At Karlsruhe there is a central school of gymnastics partly supported by the government, the object of which is to train all those who intend to teach this branch of education. Those candidates who are already employed in teaching gymnastics in various degrees complete their training in this establishment; such persons as are employed in assisting the actual professors of gymnastics are also admitted. In case of need, assistance is granted to these candidates.

This institution is also in connection with the establishments of public instruction at Karlsruhe, and especially with the lyceum. The pupils of the last-named schools receive their gymnastic lessons there, and a part at least of the pupils of other public schools may also be admitted.

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The experience of Baden in reference to Trade schools is, that the attendance of pupils should not be obligatory, and that every pupil should be required to pay a small fee. If the instruction is good and cheap, those likely to be improved will attend, and if only a moderate tuition is required and paid in advance, they will attend more promptly, regularly, and diligently.



## SPECIAL SCHOOLS AND INSTRUCTION IN BAVARIA.

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### INTRODUCTION.

THE Kingdom of Bavaria, on an area of 29,617 English square miles in 1864, had 4,807,440 inhabitants, of whom 679 out of every 1000 were engaged in agriculture, and 227 in mechanical arts and commerce, and the balance in other occupations.

The total annual expenditure of the government of Bavaria, in 1864, amounted to 46,720,597 florins, of which 902,507 florins were expended for general instruction and 138,578 for technical, making a total of 1,041,085 by the two departments for educational purposes. This amount was independent of all local expenditure, which raised the sum to about 4,000,000 florins.

The institutions of public instruction are administered by two offices; those of general education by the Minister of Education and Ecclesiastical Affairs, and those of a special character by the Minister of Commerce and Public Works.

1. *Primary or Common Schools, (Volksschulen.)*—Of these there were in 1863, 7,113 schools with 8,937 teachers and 946,275 pupils. Besides the primary-schools there are 1,550 Sunday and holiday-schools, (*Sonn-und Feiertagsschulen,*) open one or two hours on certain evenings and on Sundays, completing and extending the course pursued in the primary-schools, with 129,128 pupils. So general is the attendance on elementary-schools, public and private, that all but eight per cent. of the recruits who joined the army in 1864 read and wrote well. Besides the regular primary schools, there are 91 infant schools, with 6,796 pupils, and 143 private schools, with 6,853 pupils, most of whom are in elementary studies. Taking the whole of the kingdom, there is one primary-school for every 530 inhabitants.

2. *Secondary Schools.*—95 Latin schools or preparatory gymnasiums, with 8,205 pupils; 28 classical gymnasiums, with 3,800 pupils; 6 real or scientific gymnasiums, with 1,200 pupils; 30 public high-schools for girls, with 1,200, and 143 boarding-schools for girls, with 6,853 pupils.

3. *Superior Schools*.—10 lyceums, with university studies, attended by 700 scholars, (mostly Catholic, preparing for the priesthood;) 3 universities, (Munich, Würzburg, Erlangen,) each with four faculties, and a total of 2,959 students in 1867; 1 academy of science, with cabinet of natural history, royal library of 800,000 volumes, chemical laboratory, (under Baron de Liebig,) which are made subservient to the university at Munich. The conservatorium of scientific collections and laboratories embraces 12 sections, and has an income of 48,000 florins from the government.

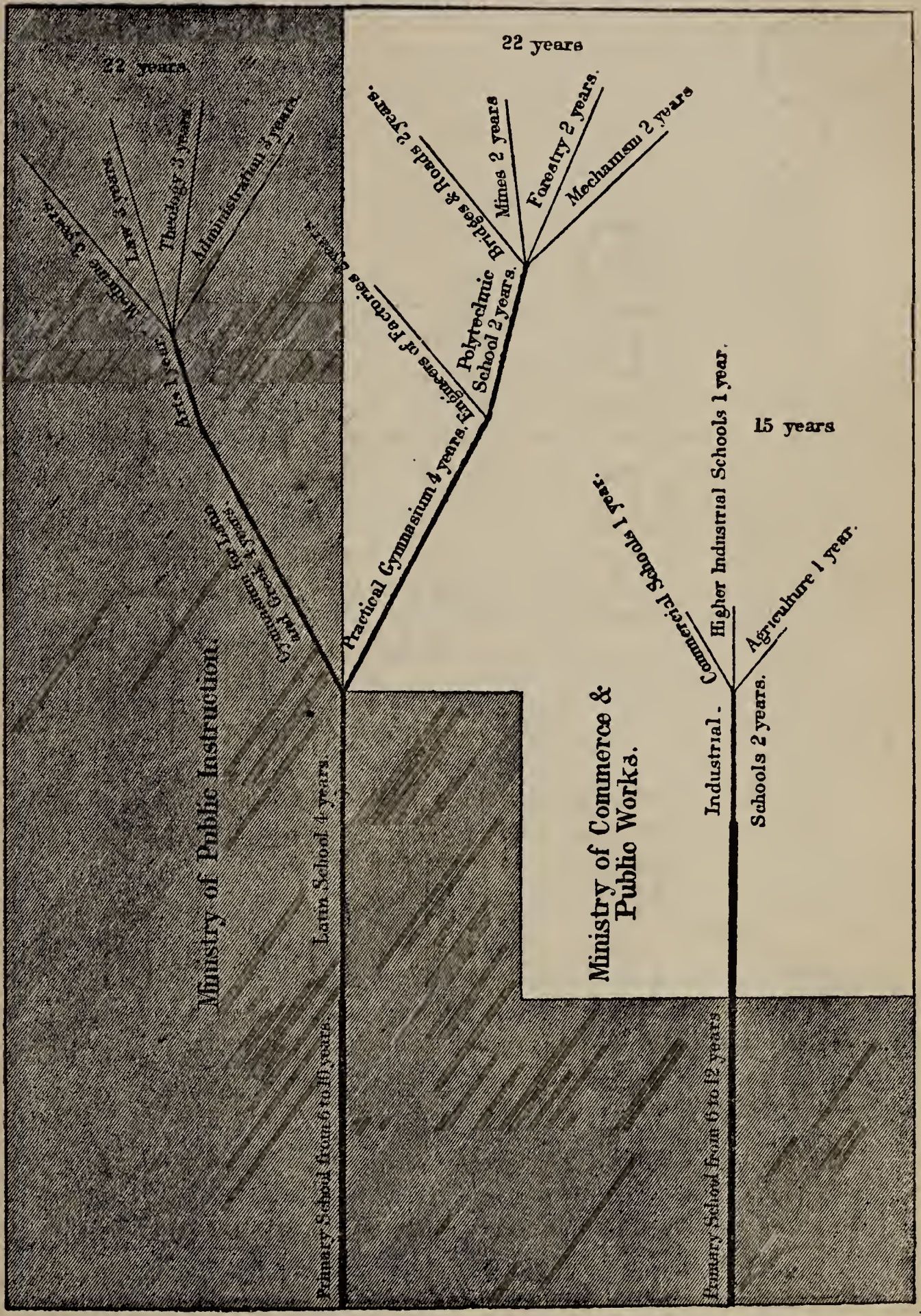
4. *Special and Professional Schools*.—Bavaria is well supplied with institutions adapted to special occupations and classes, viz.:

- 10 Normal schools for primary school teachers, with 78 teachers and 518 pupils.
- 3 Seminary courses for secondary school teachers, (one in each university, with 96 seminarists.
- 4 Superior agricultural schools, with 29 agricultural sections in the trade schools; with an aggregate of 2,114 pupils.
- 1 School of forestry, with 40 pupils.
- 1 School of horticulture, with 30 pupils.
- 1 School of veterinary surgery, with 18 teachers and 140 pupils.
- 2 Commercial schools, with 18 commercial divisions in the trade schools, and an aggregate of 2,000 pupils.
- 29 Trade schools, with an agricultural, commercial, and mechanical section.
- 3 Polytechnic schools—now existing as 1 Central Polytechnic at Munich, 1 School of Arts at Nuremberg, and the School of Machinery at Augsburg.
- 1 Academy of painting and sculpture, with 1 director, 13 professors, and 231 pupils.
- 1 School of architecture, with 9 teachers, and 143 pupils.
- 261 Schools of drawing, of which 121 are independent, and 140 are united with other institutions—with 9,973 pupils.
- 1 Conservatorium of music, with 1 director, 14 teachers, and 94 pupils.
- 10 Schools of music.
- 1 Central and 9 provincial institutions for the deaf and dumb, with a total of 23 teachers and 256 pupils.
- 1 Institution for the blind, with 3 teachers, 13 assistants, and 76 pupils.
- 1 Institution for idiotic children, with 3 teachers and 23 pupils.
- 3 Schools of midwifery, with 14 teachers and 132 students.
- 35 Orphan institutes, with 1,400 children; and 75 rescue homes for neglected and vicious children, with 2,250 inmates.

Besides the royal library of 800,000 volumes, the University of Munich has a library of 150,000; that of Würzburg, 100,000 volumes; of Erlangen, 140,000 volumes; and 24 public libraries, with an aggregate of 2,000,000 volumes.

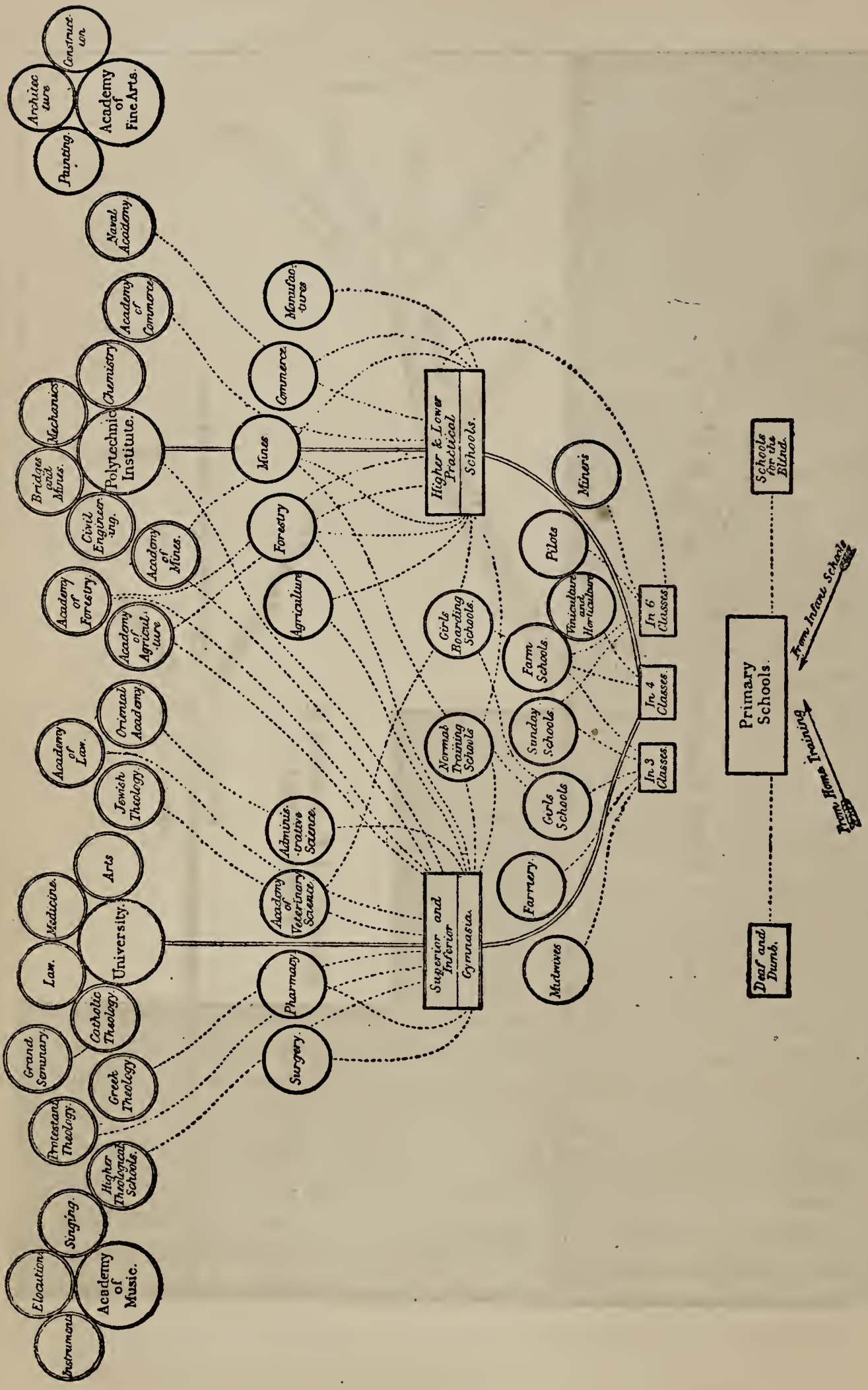
The logical arrangements of the schools of science and literature in the system of Public and Special Instruction in Bavaria impressed the French Commissioners so favorably, that they have represented them in the accompanying diagram.





BAVARIA—ARRANGEMENT OF SCHOOLS AND STUDIES UNDER DIFFERENT MINISTRIES.





AUSTRIA—ARRANGEMENT AND CONNECTION OF STUDIES IN PUBLIC SCHOOLS OF VIENNA.



## SYSTEM AND INSTITUTIONS OF SPECIAL INSTRUCTION.

Bavaria was one of the first states in Germany to found a school of art, in its highest sense, and one of the earliest to apply instruction in science to the development of mechanical industry, and to bring its young artisans and workmen of every kind into systematic courses of technical instruction.\*

The Academy of Art in Nuremberg was founded by Sandrart in 1662, and after being long conducted by him, gained new distinction under Preissler, and no school of art out of Munich has done so much in our day to develop taste and skill in artisans and artists as the Royal School of Art, and several private schools of drawing now in successful operation in that quaint old town.

The first Technical School, so called, in Germany, was opened in Nuremberg in 1823, under the lead of Scharrer, afterwards mayor of the city, who gave the impulse, by providing instruction one hour on Sunday, and two evenings in the week, in drawing (free-hand and architectural) and mathematics. He was assisted by Heideloff, architect, and Hermann, afterwards professor in the Polytechnic and counselor of state. The school was adopted by the municipal authorities, and as the instruction was of the best kind, it was completely successful, and by the expansion of its studies and length of term, grew into a Trade School, under the law of 1834, till 1836, when it had 7 teachers, with 490 pupils (one-fourth of them journeymen) in 11 divisions, receiving instruction in mathematics, drawing, modeling, molding and casting metals, wood-carving, &c. The pupils of this school, (called, in 1836, Mechanic School,) created a new trade for this district of Bavaria; and the example of special schools on Sunday, evenings, and holidays, was followed by other cities, until in several of them the mechanic schools grew into polytechnic schools—Munich in 1827, Nuremberg in 1829, and Augsburg in 1833, none of which, however, attained to the highest scientific development—the pupils not being required to go through a thorough course of theoretical study, as in some other institutions of this class. In all, the plan of instruction was pretty much the same, but gradually Munich turned its force towards construction and engineering; Augsburg and Nuremberg to mechanical handicrafts. In 1862 the school at Munich was divided into two parts, the polytechnic proper, and the school for construction and engineering.

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\* For the details of this system, see National Education, Part I, GERMAN STATES, *Bavaria*.

In 1864 the whole system of real-schools, trade-schools, and polytechnic schools, which had grown up since 1808, was reorganized. After the law of 1808, real-schools and real-institutes were set up in the large centres of population parallel with the progymnasiums and gymnasiums. The real-schools added to the elementary course the study of French, drawing, the elements of natural history, and algebra. The real-institute added to the real-school course, which usually terminated at the fourteenth year, the natural sciences, more of mathematics, history, general philosophical studies, as well as the literature of modern languages. This course, if carried out, occupied four years, and was intended to prepare for higher academical studies and for special careers, such as financiers, merchants, &c. The system did not work well, and was modified in 1816—the real-institutes being discontinued, and the real-schools converted into higher burgher-schools—which were only the higher classes of an elementary school. The deficiency of State realistic seminaries was partially supplied by the municipal authorities, associations and individuals, in artisan schools, further-improvement or Sunday-schools, mechanic schools, and polytechnic institutes, in which the arts of design and drawing received particular attention. To give this new instruction, which the necessities of society had created, thorough organization and symmetry, the government, in 1829 and in 1833, decreed the establishment of technical schools in all the large cities of the kingdom. The law of 1833 discontinued the higher burgher-schools and laid down the outline of a course of instruction for the technical schools, which was perfected by the law of 1836. The object of the technical schools, in the language of the law, is “to carry the sciences into industry, and to put industrial pursuits themselves upon a footing corresponding to the progress of technical art and the competition of foreign industry.” With this aim the technical schools had their central point in the exact sciences, and were preparatory for, 1, the artist’s vocation proper; 2, the technical branches of the public service, especially architecture, mining, salt works, and forests; 3, for technical departments of civil life; 4, for strictly civic vocations, particularly for carrying on improvements in manufacturing, agricultural, and mechanical industries.

In the development of this system there sprung up, and existed in 1863, the following institutions:

1. Schools of arts and trades, or technical gymnasiums, with an agricultural, commercial, and mechanic arts division. Of these there were twenty-nine, in as many centres of population and in-



dustry. They received pupils at twelve years of age, and dismissed them at the end of three years. With several were connected preparatory schools, and with all, a Sunday and holiday or feast-day school for apprentices and journeymen.

2. Polytechnic schools or technical lyceums. Of these there were three, located at Munich, Nuremberg, and Augsburg. They received their pupils at the completion of their fifteenth year, and with a preparation equal to the attainments of the graduates of the technical gymnasium.

3. Special courses, or schools for the completion of technical instruction: (1,) engineering in the polytechnic school at Munich; (2,) mining, foundries, and salt works in the department of public economy in the University of Munich; (3,) higher forestry service in the Royal Forestry School at Aschaffenburg, and one year in the University; (4,) higher agricultural training, in the Central School of Agriculture at Weihenstephan, near Freising; (5,) for the fine arts, including architecture and ornamentation of an artistic character, the Royal Academy of Arts in Munich, and (6,) for higher chemical analysis, the laboratories of the Academy of Science, the Conservatorium, and the University.

This system, although it developed a prodigious amount of scientific and artistic talent, and in several directions, of improved industrial fabrics, did not satisfy all the wants of different classes and different industries. In consequence of "urgent pressure from the Department of Commerce and Public Instruction," the king promulgated in 1864 a new law respecting technical institutions, according to which they are now classified and administered.

#### EXISTING ORGANIZATION OF TECHNICAL INSTRUCTION.

The system of technical instruction, as organized under the law of 1864, and in force after 1868, when the classes under the former system will have completed their curriculum, and the new classes will be in full operation, consists of—

I. The trade-school, (*gewerbschulen*—twenty-nine in all, located in the principal centres of population and industries,) designed to impart a fitting general education, and the theoretical knowledge preparatory to different occupations, and the professions in which science forms the basis of the highest success. The instruction begins where the common school leaves off, and while it is passably complete in itself, it is the systematic preparation for a more extended course in commercial and agricultural studies which can be

organized in the institution with the sanction of the highest authorities, or pursued in the special institutions of a higher grade.

Eight of these institutions, one in the chief town of each of the eight districts or circles into which the kingdom for administrative purposes is divided, are designated in the law as district or higher trade-schools.

II. The real-gymnasium—this class of schools, of which there are six, one in the chief town of each of the six provinces, is of a higher grade than the trade-school, and includes, in a four years' course, the study of Latin and one or more modern foreign languages. It presupposes the attainments of the primary-school and of the first year of the classical gymnasium, with which its first year is parallel. The final examination and certificate entitles to admission into the polytechnic school at Munich, and into the university, for participation in such studies as do not fall within the special limits of the three faculties of theology, jurisprudence, and medicine, and if found qualified after special examination, into the higher special schools of forestry, agriculture, veterinary science, or separate branches of the public service.

III. The polytechnic school at Munich, in which the different professional studies of engineering, architecture, technical chemistry, trade and commerce, are treated independently of each other, in courses of two years each, on the basis of a common scientific instruction in mathematics and the natural sciences, and the art of drawing, pursued to the extent deemed necessary for each professional course.

The Royal School of Machinery at Augsburg, and the Royal School of Art at Nuremberg, both of which were polytechnic schools up to 1865, are not yet permanently organized as part of the system. Their present course of instruction exceeds the course of the district trade-schools, and falls short of the Central Polytechnic School.

With each of these institutions or their teachers are associated, more or less directly, supplementary schools and classes, designed to impart instruction in subjects of immediate utility to apprentices and workmen in various crafts and occupations; and above them all in the lectures, collections, libraries and laboratories of the universities, and in the higher special schools of agriculture, forestry, and art, the student can carry his artistic, artisan, or purely scientific studies to the highest point.

We append the substance of the regulations recently issued for the government of these schools:



## TRADES SCHOOLS.

The trades schools of Bavaria were originally known by the name of agricultural and industrial schools, but received their present name in the decree of 1864. They are generally government institutions, but the municipalities or associations contribute more or less to the support of some of them, the teachers being appointed by the power that supports them, although all the appointments must be confirmed by government.

The qualifications for admission are that the candidate shall be between the ages of twelve and fourteen; shall be able to read, write and compose without gross blunders in spelling or language; shall be master of the first four rules of arithmetic, and possess a proper knowledge of religion.

The plan of studies occupies three years, and is as follows :

Hours per week.	Course I.	Course II.	Course III.
Religion, . . . . .	2	2	2
German, . . . . .	5	4	3
Geography, . . . . .	2	2	2
History, . . . . .	2	2	2
Arithmetic, . . . . .	5	0	0
Algebra, . . . . .	0	2	4
Natural History, . . . . .	4	4	0
Physics, . . . . .	0	4	0
Drawing, . . . . .	8	8	4
Modeling and embossing, . . . . .	0	2	6
French, . . . . .	2	2	2
Plane geometry, . . . . .	0	4	0
Descriptive " . . . . .	0	0	2
Solid geometry and plane trigonometry, . .	0	0	2
Chemistry, . . . . .	0	0	4
Popular mechanics, . . . . .	0	0	4

Making thirty hours a week for each class.

In some places part of the scholars pursue a commercial or agricultural course of study, varying in some particulars from the above. Those in the commercial section omit drawing and embossing, algebra, geometry, trigonometry, and mechanics, devoting three hours more a week to French during the whole course, and studying calligraphy, arithmetic, the science, geography and history of commerce, and in the last class, English.

Those in the agricultural section omit natural history, physics, algebra, descriptive geometry and plane geometry, mechanics, and French, and have only two hours a week in drawing. They add to the course the study of husbandry and rural economy, with practical labor on the farm, nine hours in the first class, six in the second and third.

*Sunday, Holiday, and Evening Trades Schools.*

Connected with the district trade-schools there is a higher class of supplementary schools whose object is to impart a free education to those apprentices or workmen whose education has been neglected, and to offer the means of farther advance to those who have finished the course of the trade schools, in the buildings of which they are generally held, although in some cases they form separate institutions. The only requirement for admission is having attended the primary-schools during the six years required by law. The instructors are generally the teachers of the trade-schools, but practical workmen are engaged to teach particular handicrafts. The schools are held on Sundays, holidays, and two evenings in the week. The course is divided into two sections, the ele-

mentary, which is a continuation of the course pursued at the primary-schools, and the special section, dealing with matters of trade and commerce, and with practical trades or handicrafts.

In the elementary section are taught religion, German, arithmetic, and drawing. Under German are included composition, commercial style, &c.

In the special section are taught drawing, embossing, modeling, arithmetic in its applications to trade and commerce, geometry, natural history, the history of staples, mercantile book-keeping, and practical exercises in different trades and handicrafts. There are fourteen of these institutions, attended by 560 scholars. They are supported by the communes or from other local sources.

#### THE REAL-GYMNASIUMS.

The real-gymnasiums of Bavaria, sometimes called technical gymnasiums, have for their aim to give "the requisite preparation for entering upon the study of a profession which demands an intimate acquaintance with the exact sciences." They are at once literary and scientific. There are six of these schools.

They are all government institutions, and the teachers, who must have been graduates of a Latin-school, a polytechnic school, and have spent at least one year at a university in their special study, are considered government employés.

Pupils are admitted between the ages of thirteen and sixteen, after having completed the course at a Latin-school, or passing an examination upon the studies there pursued. Hospitants are received only exceptionally. The academical year begins October 1st and ends August 15th, with a fortnight's holiday at Easter. The courses are all obligatory and as follows:

*Course I.*—Religion, 2 hours per week; Algebra, 4; Plane geometry, 3; German, 4; Latin, 4; French, 4; Geography, 3; Drawing, 6.—Total, 30 hours.

*Course II.*—Religion, 2 hours per week; Algebra, 3; Plane geometry, 2; Natural history, (zoölogy and botany,) 4; German, 3; Latin, 4; French, 4; Geography, 2; Drawing, 6.—Total, 30 hours.

*Course III.*—Religion, 2 hours per week; Solid geometry, 2; Algebra and trigonometry, 4; Physics, 5; Descriptive geometry, 2; German, 2; Latin, 3; French, 3; History, 2; Drawing and embossing, 6.—Total, 31 hours.

*Course IV.*—Religion, 2 hours per week; Elements of higher analysis, 2; Analytical geometry, 2; Descriptive geometry, 3; Mineralogy and chemistry, 5; Latin, 3; French, 2; English, 4; History, 2; Drawing and modeling, 6.—Total, 31 hours.

Annual written and oral examinations take place, and the pupil who fails two years in succession in one of the lower classes is excluded from the school. At the close of the course a pupil may demand to be specially examined for an absolutorium, which is in writing, and extends over three days, as follows:

*First day.*—1. A religious theme to be completed in one hour; 2. A historical essay in German on some given subject, three hours; 3. A problem in descriptive geometry, two hours; 4. Two themes, one in zoölogy, one in botany, one hour.

*Second day.*—1. Solution of two problems in the lower and one in the higher analysis, two hours; 2. Solution of two problems, one in elementary and one in analytical geometry, two hours; 3. Two themes in physics, one hour; 4. A French composition, two hours.

*Third day.*—1. Solution of two problems in trigonometry, two hours; 2. Two themes in chemistry, one to have reference to mineralogy, one hour; 3. A Latin composition, two hours; 4. An English composition, two hours.

Every scholar pays 20 florins annually; hospitants only half this sum if they attend but one course. The whole may be remitted to poor and capable students.



## THE POLYTECHNIC SCHOOL.

In the organic system of the technical institutions, the polytechnic school stands in immediate connection with the real gymnasium, and forms the apex of the system of technical instruction.

In place of three, the law designs to place at least one school on the basis of a broad and thorough scientific preparation, and then to provide for at least four leading interests by a complete course in each.

It is divided into—

- A. A general class, and
- B. Special classes for individual branches of technical business.

The general class or division comprises a course of two years, and its object is to impart instruction in the mathematical and natural sciences, and the art of drawing to the extent required to make them a general foundation for the commencement of separate branches of technical studies, and at the same time to constitute a course of general scientific culture.

The special classes are to impart knowledge of and skill in the particular sciences required in individual branches of technical business, and these studies, in organic connection with the studies of the general class, are to complete the technical professional education.

The polytechnic school comprises four special classes or divisions:—

- A. For architecture, the course extending over two years.
- B. For mechanical engineering, the course extending over two years.
- C. For technical chemistry, the course extending over two years.
- D. For trade and commerce, the course extending over one year.

The principal object of the polytechnic school is to treat the different professional studies independently of each other.

The preliminary studies lead up to these, and must therefore precede these in the degree prescribed and deemed necessary.

In order that the regular gradations which are considered absolutely necessary may be observed, the students must strictly follow the courses of instruction laid down.

## A.—GENERAL DIVISION.

## COURSE I.

LESSONS.	Hours in the Week.	Semester I.	II.
Analytical geometry . . . . .		3	3
Differential and integral calculus . . . . .		4	4
Analytical mechanics . . . . .		5	5
Mathematical physics . . . . .		6	0
Applied physics with practical exercises . . . . .		0	6
Elements of architectural construction . . . . .		6	6
Elements of machine construction . . . . .		6	6
Free drawing . . . . .		6	6
Elementary mechanics . . . . .		5	5
Zoölogy . . . . .		5	0
Botany . . . . .		0	5
Political economy . . . . .		4	0
French language . . . . .		3	3
Italian language . . . . .		3	3
History of German literature . . . . .		2	2

## COURSE II.

LESSONS.	Hours in the Week.	Semester I.	II.
Applied mechanics.....	5	5	5
Application of descriptive geometry to perspective, shading and stone-cutting.....	3	3	3
General chemistry.....	4	0	0
Special chemistry.....	0	4	4
Oryctognosy.....	4	0	0
Geology.....	0	4	4
Architectural designing (construction and architectural forms).....	6	6	6
Machine designing (elements of construction).....	6	6	6
General knowledge of machinery.....	6	6	6
Constitutional and administrative law.....	4	0	0
French language.....	3	3	3
English language.....	3	3	3
Italian language.....	3	3	3

## B.—SPECIAL DIVISIONS.

## I. ARCHITECTURAL CLASS.

On entering this class the pupil is supposed to be in possession of such knowledge of the subjoined subjects as is taught in the two courses of the general division.

Analytical geometry, differential and integral calculus, analytical and applied mechanics, mathematical and applied physics, general and special chemistry, applied descriptive geometry, oryctognosy, geology, architectural and mechanical designing, drawing, (the latter studied during two hours a week,) and political economy.

## COURSE I.

*a. For architects and building engineers in common.*

LESSONS.	Hours in the week.	Semester I.	II.
General civil engineering.....	2	2	2
Knowledge of building materials, and of sanitary matters connected with building.....	0	4	4
Estimates of cost, and conditions of contract.....	4	0	0
Plan drawing ( <i>Situations zeichnen</i> ).....	4	4	4

*(b.) Separate instruction for architects.*

Architectural styles and history of architecture.....	4	4	4
Plans of elevation ( <i>Hochbauten</i> ).....	14	14	14
Figure and landscape drawing.....	4	4	4

*Separate instruction for building engineers.*

Bridge building.....	4	4	4
Plans of bridges.....	8	8	8
Geodosy and hygrometry.....	6	6	6
The construction of machinery.....	4	4	4

## COURSE II.

*(a.) For architects and building engineers in common.*

Plans of architectural buildings.....	6	6	6
Plans of engineering works of construction.....	6	6	6
Stone cutting and modeling.....	0	4	4
Constitutional and administrative law.....	4	0	0



*(b.) Separate instruction for architects.*

History of architecture.....	2	2
Elements of the science of road building, bridge building, and the construction of water works.....	2	2
Measurement.....	0	4
Plans of architectural buildings.....	12	8

*Separate instruction for engineers.*

Science of road making and of constructing water works.	6	6
History of engineering.....	2	2
Plans of engineering works.....	8	8

## II. MECHANICAL ENGINEERING.

On entering this division the pupil is supposed to be in possession of such knowledge of the subjoined subjects as is imparted in the two courses of the general division:

Differential and integral calculus, analytical geometry, the application of descriptive geometry, mathematical and applied physics, designing (architectural and mechanical,) general knowledge of machinery, analytical and applied mechanics, general and special chemistry, geology.

## COURSE II.

LESSONS.	Hours of the week.	Semester I.	II.
Theory of machinery ( <i>Maschinenlehre</i> ).....	4	4	4
Construction of machinery.....	4	4	4
Exercises in designing.....	8	8	8
Railway, canal, &c., engineering.....	3	0	0
Leveling and measurements.....	0	4	4
Manufacturing engineering ( <i>Fabrikbau</i> ).....	0	3	3
Metallurgy.....	5	0	0
Technology (of manufactures, building trades, and implement making).....	0	0	0
Excursions: practical work in the mechanical workshops.....	0	0	0

## III. TECHNICAL CHEMISTRY.

On entering this division the pupil is supposed to be in possession of such knowledge of the subjoined subjects as is imparted in the two courses of the general division:

Zoölogy, botany, oryctognosy, geology, mathematical and applied physics, general and special chemistry, architectural drawing.

## COURSE I.

LESSONS.	Hours in the week.	Semester I.	II.
Elementary mechanics... ..	5	5	5
Technical physics (pyrotechnics).....	4	0	0
Technical chemistry.....	5	5	5
Elements of mechanical designing.....	6	6	6
Knowledge of building materials.....	0	4	4
Political economy.....	4	0	0
Work in the laboratory.....	0	0	0

## COURSE II.

LESSONS.	Hours of the week.	Semester I.	II.
General theory of machinery.....		6	6
General civil engineering.....		2	2
Metallurgy, including smelting and casting.....		5	0
Physical chemistry.....		5	0
Technology.....		5	5
Work in the laboratory.....		0	0

## IV. TRADE AND COMMERCE

## SOLE COURSE.

LESSONS.	Hours of the week.	Semester I.	II.
Theory of commerce, including the sciences of the counting-house.....		6	6
Commercial geography and commercial statistics.....		2	2
History of commerce.....		0	2
Laws relating to commerce and bills of exchange.....		0	3
Political arithmetic.....		0	3
Commercial arithmetic.....		3	0
Knowledge of goods.....		3	3
Mechanics (as applied to the means of transport).....		0	2
Political economy.....		4	0
Constitutional and administrative law.....		4	0
French language.....		3	3
English.....		3	3
Italian.....		3	3
Mercantile correspondence in French and English.....		0	3

Previous to the commencement of a term of studies, the directors of the establishment must determine, with the aid of the masters of the various divisions, the programme of studies, and this must then be published.

The institution is managed by a board of directors.

Admission to the special divisions or schools is based on a thorough mastery of the two preparatory courses, and to their equivalent in mental discipline and knowledge obtained in a real gymnasium.

On entering the Polytechnic School, regular pupils and hospitants, must pay an admission fee of five florins.

The school honorarium is twenty florins per semester. Hospitants pay four or six florins, according to the number of lessons they take weekly.

For participation in the work of the laboratory, pupils pay fifteen florins, and hospitants twenty florins.

Individuals giving proof of special worth and abilities, and at the same time of incapacity to pay, may be absolved from payment of the above fees.

An absolutorial examination is held at the close of each school-year, the subject of examination being fixed by the professors in council.

Such are the principal provisions of the new regulations for the government of the Central Polytechnic School at Munich.

Up to the reorganization of technical instruction in 1864, the three schools at Munich, Nuremberg and Augsburg, had the same general characteristics. Under the present plan, much higher scientific culture will be attainable at Munich, while a very thorough special course in construction and manufactures will be given, the first at Augsburg, and the last at Nuremberg.



## SCHOOLS AND CLASSES FOR TECHNICAL INSTRUCTION.

Out of the many excellent institutions and classes for technical training in the arts of construction, ornamentation, and industrial production generally, of which we have received recent programmes or find described in the Reports of the French and English Commissions, we will present specimens of each grade.

## SUNDAY IMPROVEMENT-SCHOOLS.

The Sunday-school in Germany is not, in its aim and instruction, identical with the institution known by that name in England and the United States, the great leading object and characteristic of the latter being almost ignored in the former—we mean religious instruction. The name is sometimes applied to schools taught in the evening of other days, or in the morning for one or two hours before nine o'clock, in harvest time and on church holidays, although generally these last are called by the name of the day on which they are held. All of these schools, however called, are in the first place review or repetition schools, for those who have left at the age of twelve or fourteen the instruction given in the regular primary-school, or they continue elementary instruction in the direction of the special occupation in which the pupils are already engaged, or for which they are destined. In the latter condition, they are frequently known as trade improvement-schools, commercial improvement-schools, or agricultural improvement-schools. In this view of their aim and methods, they constitute a highly valuable part at once of the system of popular and of technical instruction. Infrequent and short as the sessions are, they fix a large amount of valuable knowledge in the memory by timely repetition, and add to the stock just that kind of knowledge which in his daily avocations the pupil feels to be necessary and useful, and which thus passes as it were into the substance of the mind—his daily thinking and practice. Such educators as Niemeyer, with a full knowledge of the operation of these schools, expresses himself very favorable to this class of schools. "It would be a great gain in every place, large or small, city or village, if young persons, servants, apprentices, clerks, could have, every week, even one or two hours of regular instruction and mental exercise, under the care of a well-qualified teacher." Although the practice has been opposed, on account of its violating the usual observance of Sunday, and its interfering with the engagements of teachers as organists, and adding to their already heavily-taxed services, as well as on account of the very restricted range of instruction—the system continues; and *Further Improvement Schools*, under some name, and on several hours of the week, constitute an important part of the elementary and technical education of the working classes of Germany.

Sunday-schools have existed in Wurtemberg since 1695, (for children not yet confirmed, and to prepare them for confirmation,) in Baden since 1754, in Prussia since 1763, and in Bavaria since 1803. They are established by law in Austria, Bavaria, Coburg-Gotha, Nassau, and other States, while in Saxony and Hesse their institution depends on the action of the separate communities. When they exist by law, the same studies are pursued as in the regular common or primary-school, and always attended by those whose opportunities of school-attendance on week-day schools have been abridged. There is, however, in

these States frequently a class of pupils who have completed the regular course at fourteen years of age, and devoted two years more to additional instruction. With these pupils, and in schools in large commercial, mechanical, and other centres, the instruction is generally technical, and is given by experts, and is, not unfrequently, of the highest value.

#### SUNDAY-SCHOOL AT NUREMBERG.

The technical school founded in 1823, when on Sunday mornings the architect Heideloff gave instruction in free-hand and architectural drawing; Hermann, professor in the gymnasium, taught mathematics; and Keippler, the mechanician, taught machine-drawing—has continued to the present time, with a constantly-widening range of studies in additional classes, which were provided for in two evenings of each week. The average attendance from 1837 to 1853 was 700; in 1854 it was 1,200, and in 1856, it amounted to 1,600.

The establishment combines the teaching of drawing, modeling, sculpture, and engraving, with elementary instruction in geometry, arithmetic, physics, and chemistry. The first and most important part of the curriculum is connected with the arts of design. The first and second courses, graduated according to the capabilities of the pupils, are devoted to free-hand drawing, ornaments, architectural drawing, with or without shading, figure-drawing, geometrical drawing, and tinting in Indian ink. The third course has four divisions, according to the special destination of the pupils: the first division comprises every thing connected with buildings, from the first details of masons' and carpenters' work to the types and styles of architecture; the second is devoted to joiners' work; the third to turners in wood or metal; the fourth to divers trades.

The second part of the curriculum teaches modeling in wax, clay, or plaster, engraving, and sculpture. The third is devoted to arithmetic and geometry applied to mensuration of superficies, solids, and to plotting. The fourth imparts the rudiments of physics and mechanics, so far as applicable to local industries. The fifth and last treats of industrial chemistry. These courses were attended, in 1864, by 228 pupils for drawing, and 1,354 hearers for the other courses.

#### SUNDAY AND HOLIDAY SCHOOLS IN MUNICH.

As a specimen of the city Sunday and holiday schools, we give an account of the large central institutions of this class in Munich, from the annual report of the committee for 1866-67:

Every ordinary parish-school has attached to it a holiday school, which is, therefore, called a parish holiday school, and which consists of three classes designated by the numbers I, II, and III.

There is, in addition to this, a central holiday educational institution, which embraces the whole city, and which has also three subdivisions, viz.:

(a.) *The Central Holiday School*, an elementary school with three morning and three afternoon classes, designated by the numbers IV, V, VI.

This central holiday school is not, however, supplementary to, or a continuation of the parish holiday schools in so far that scholars must necessarily pass into it from these latter. It obtains its scholars from among such as have (1) passed through course IV, (2) who having performed their duty in the week-day schools, have left these with certificate No. 1, and (3) who leaving a higher educational institution, after the probationary months, have returned to the



workshop. Such pupils must not be admitted into the parish holiday schools, but must be sent to the central holiday school.

(b.) *The Journeymen's School.*—This embraces four classes, and imparts, during one hour of the morning, elementary instruction to journeymen, who are either still within the age fixed for attendance at school, or who, feeling the deficiencies of the school instruction they have previously received, voluntarily enter their names in this institution. This being once done, they are, like the other scholars, bound to attend during the whole year.

(c.) *The Holiday School for Handicrafts*, in which instruction is given in—1. Geometry and arithmetic; 2. Physics; 3. Technical chemistry; 4. Descriptive geometry, theory of machinery, and mechanical designing; 5. Practical mechanics; 6. Free-hand, geometrical, and architectural drawing.

The last branch of instruction is divided into five regularly-organized classes, four of which have of late years had to be subdivided into eight parallel classes, on account of the great number of students attending them.

The uniformity of the instruction given, and its regularly progressive character is insured by the supervision of a technical director, under whom rank also the holiday drawing-schools in the suburbs of Au, Haidhausen, and Giesing, which form branches of the central drawing-school.

This central school is so regulated as to be in strict harmony with the system of drawing-instruction introduced into all the week-day schools.

SOLE COURSE.	Hours in the week.	Semester I.	II.
Theory of commerce, including the sciences of the counting-house, . . .	6	6	
Commercial geography and commercial statistics, . . . . .	2	2	
History of commerce, . . . . .	0	2	
Laws relating to commerce and bills of exchange, . . . . .	0		
Political arithmetic, . . . . .	0	3	
Commercial arithmetic, . . . . .	3	0	
Knowledge of goods, . . . . .	3	3	
Mechanics, (as applied to the means of transport,) . . . . .	0	2	
Political economy, . . . . .	4	0	
Constitutional and administrative law, . . . . .	4	0	
French language, . . . . .	3	3	
English, . . . . .	3	3	
Italian, . . . . .	3	3	
Mercantile correspondence in French and English, . . . . .	0	3	

Previous to the commencement of a term of studies, the directors of the establishment must determine, with the aid of the masters of the various divisions, the programme of studies, and this must then be published.

It must be observed that in the instruction given in this institution each handicraft is taken into due account, so that each pupil may obtain the knowledge specially required for his trade.

With the holiday school for handicrafts is connected a lithographic establishment, which supplies the drawing-schools with systematically-arranged models, and thus maintains the regularly progressive character of these.

The schools enumerated under *a*, *b*, and *c*, constitute together one great whole, under the superintendence of a special inspector. The guidance of it is, however, beset by great difficulties, and demands an amount of tact and energy which will be easily appreciated by those who know, by actual intercourse with them, the character of our apprentice boys. It is, therefore, the more to be admired that among so large a number of scholars brought into such close contact with each other, so few aberrations should have taken place.

The female holiday schools are, like the male schools, divided into:—

- a.* A central holiday school; and
- b.* Parish holiday schools.

The first mentioned consists of three classes, which, to distinguish them from the lower holiday schools, are designated by the numbers IV, V, and VI. No. IV is, on account of the great number of scholars, subdivided into three classes, viz., A, B, and C; and instruction is given both in the morning and in the afternoon, in order to render it more easy for the girls to attend.

With this school is connected a so-called preliminary division, in which girls who have been unfavorably situated with regard to the attainment of education are enabled to obtain proper instruction. This division has been incorporated with the central holiday school, because, as in its object and its methods of teaching it holds an exceptional position, it would otherwise be quite isolated; and because, were the pupils who frequent it to be distributed among the parish schools, they would fail to obtain the special attention which their case requires.

In connection with this school there is also a class for instruction in partial work, which is open to girls who have already gone to service, as well as to others.

The elementary instruction, which increases in each class, and which in classes V and VI extends to practical life, was, during the last year, attended by 504 girls, and the working class by 125 girls.

In all its features, both as regards the teachers and the greater number of the scholars, in their efforts to impart and to attain culture and dignity, this school offers a most attractive picture of what holiday schools may be.

#### *Holiday Schools for Girls.*

b. The parish holiday schools for girls, of which there were, during the year, 11, with 27 classes, also effect much that is good and useful, yet it can not be denied that their effectiveness might be far greater. The chief obstacle to their activity is not only the lukewarmness of the scholars themselves, but more especially the contempt in which the schools are held by many parents and employers.

Prizes, mostly consisting of money, are annually distributed in all these schools, and the names of the scholars who have distinguished themselves by steady industry are published in the yearly reports.

During the school-year 1866-67, the number of pupils attending these various schools and classes has been as follows:—*The Sunday and Holiday School for Handicrafts*:—Religious classes, 208; arithmetic and geometry, 65; physics, 64; technical chemistry, 99; descriptive geometry, 62; theory of machinery, 79; designing, 63; practical mechanics, 50; embossing, 77; chasing, 22; architectural drawing, 88; linear, 299; more advanced ornamental drawing, 367; free-hand drawing and elements of ornamentation, 296. *The Journeyman's School*, 167. *The Central Holiday School for Boys*, 341. *The Parish Holiday Schools for Boys*, 1,467. *The Central Holiday School for Girls*, 644. *The Parish Holiday Schools for Girls*, 1,303.

#### DISTRICT TRADE-SCHOOL AT NUREMBERG.

The district trade-school at Nuremberg will serve as an example of the highest grade of these schools: 1. The district trade-school; 2. The Sunday-school for artisans; 3. The elementary drawing-school.

1. The *district trade-school* affords instruction to persons who require for the intelligent pursuit of their several callings a knowledge of mathematics, of natural philosophy, and facility in drawing and modeling, or to such as wish to devote themselves to the technical service of the State. It also serves as preparatory to the Polytechnic School. The instruction embraces in a course of three years:—

Religion, German and French languages, history, geography, elementary mathematics, physics, theoretical and practical chemistry, mechanics, technology, geometry, plane and solid, trigonometry, natural history, free-hand and linear drawing, modeling in clay and wax.

After the first year, pupils who take a commercial career devote more time to the French and English languages, arithmetical calculations, and geography in reference to the natural resources and industries of nations, and to commercial forms. Those whose destination is agriculture, pursue chemistry in reference to soils, and the implements and processes of husbandry.

The first instruction in drawing is according to Wolff's principles of rational instruction in drawing, the more advanced from large drawings and solid



objects. In all the classes there are from seven to eight hours for drawing weekly.

2. The *Sunday-school for artisans* gives instruction to apprentices and journeymen in drawing, modeling, engraving, arithmetic, geometry, physics, and chemistry. The instruction in drawing, in three courses, begins with free-hand drawing according to Wolff's system; then follows the drawing of ornaments, vases, &c., in outline, with reference to the trade of the pupil, geometric drawing, drawing from bas-reliefs; finally, in the last course, special drawing. This is divided into four sections:—*a.* For builders; *b.* For joiners; *c.* For turners; *d.* For workers at various trades.

3. The *elementary drawing-school* is for those boys who are still attending the popular school, and who wish later to engage in a trade, after which they enter into the trade-school. In two courses drawing and modeling alone are taught.

All these schools in Nuremberg have a large number of pupils. In 1867 the first had 212, the second 1,876, and the last 228 pupils. The school-fees in the trade-school and the elementary school amount, at the most, to two florins annually; on the other hand, there is for apprentices and journeymen under eighteen years of age, a strict compulsory school attendance.

The annual income of the above schools from the town and the State amounts, exclusive of premises rent free, to 16,000 florins, to which add the amount of school-fees received, 1,800 florins, and we get the total cost at 17,800 florins. The establishments in Nuremberg possess a library, out of which works of general utility and belles-lettres are lent to diligent pupils. It thus gives an opportunity of rewarding good behavior, and is also calculated to impart much information which the school does not teach. A bad choice of books is also in this way prevented.

#### HIGHER TRADE-SCHOOL AT PASSAU.

The trade-school at Passau is organized with two divisions; with 57 pupils in 1867 in the commercial and 44 in the industrial or mechanical division—both under a rector, assisted by 14 teachers.

The special subjects included in the commercial division, besides the French and English languages, are thus drawn out in the programme:

**COURSE II.—*Commercial Arithmetic.***—Calculation of profits by multiplication and division. Compound rule of three. Simple and complex partnership accounts. Compound calculations and calculation of per centage. Calculation of interest, and discount. Lessons in the knowledge of coins, measures, and weights. Bankers' accounts. Direct and indirect reduction of bills of exchange. Bills of lading and invoices.

***Mercantile Science.***—The most essential parts of the theory of banking, with explanation of the most common terms used in banking. Making out of various forms of bills of exchange. Invoices and calculations. Simple book-keeping. Elaboration of a course of business, making the necessary entries connected with it in the proper books, and then making up the latter. Composition of the most important letters for simple book-keeping. Opening and closing of accounts current according to various rates of interest.

**COURSE III.—*Mercantile Science.***—Arbitration. Banking commissions. Public stocks. Customs and trade regulations. Commercial associations and mercantile systems. Book-keeping by double-entry; composition of most important letters for this.

***Commercial Geography and Commercial History.***—The various States of Europe, with reference to their commercial productions, the principal seats of their commerce and industry, their lines of traffic, their customs, laws, &c.

***The Nature of Colonies.***—Synoptic history of commerce during the middle ages, more particularly of German commerce. Influence of geographical discoveries, and especially of the discovery of America, and of the ocean road to India, on the intercourse of nations. Commercial history of the European maritime powers in modern times.

The *higher improvement-school* at Passau, opened in 1866, provides for instruction on Sunday mornings and week-day evenings, and has been well attended, mostly by adult apprentices and assistants; several master-workmen also have attended. It has a rector and four teachers (masters,) and the branches taught are book-keeping, commercial science, geometry, natural philosophy, chemistry, technology, and drawing. Its pupils number one or two hundred.

*Weaving-school.*—Connected with the higher trade-school at Passau is a weaving-school, teaching the whole art, including the history and preparation of the materials, hemp and flax. This is also a week-day and Sunday-school. There are thirty-three pupils.

Regular conferences of weavers are held in connection with these schools.

#### WEAVING-SCHOOL AT MÜNDEBERG.

The weaving-school at Mündeberg is intended to impart thorough theoretical and practical instruction in weaving in all its branches, and to give instruction not only to pupils, but to give whatever information may be demanded by any body already in the business. It is open to young men from fourteen to twenty-two years of age, from the whole province of Voigtland, preference being given to natives of Mündeberg. It is a boarding-school, and is provided with two salaried masters and one pupil-teacher.

The course embraces two years, during both of which are taught German, arithmetic, geography, drawing, and religion. During the first, pupils are taught the simpler processes connected with weaving, and the weaving of plain fabrics; during the second, theoretical and practical instruction is given in the more advanced processes. Certain manufacturers in the neighborhood furnish the raw materials and buy the woven fabrics at the usual rates. There are sixteen pupils. Bavarians pay 150 florins, natives of other countries 200 florins annually for board, lodging, and instruction, in addition to which the school receives their earnings.

Connected with the school is a gratuitous Sunday-school, open from 1 to 3 P. M., of two classes, the first of which is open to all persons engaged in industry without exception, teaching German, compositions being written on subjects relating to trade, arithmetic, linear and free-hand drawing. The second class imparts theoretical and practical instruction in their trade to weavers alone.

#### WOOD-CARVING SCHOOL AT BERCHTESGADEN.

At Berchtesgaden, in the Salzburg district, a technical-school has been instituted by the government, in aid of an industry which has long been carried on in that mountainous region, namely, the handiwork of carving ornamented articles in wood and bone.

The course embraces instruction in drawing, modeling, and carving, free of charge to all persons domiciled in the district, and to strangers who pay a small tuition.

The school is well supplied with patterns and models, and there is a repository in which the work of the pupils is sold for their benefit. The school-hours are from 7 to 11 A. M., and from 12 to 4 P. M. The pupils are arranged in two classes, and can remain four years.



## ROYAL SCHOOL OF MACHINERY AT AUGSBURG.

The Royal School of Machinery at Augsburg was formerly a Polytechnic school, but under the law of 1864 it has a special organization. The conditions for admission are a thorough knowledge of algebra, inclusive of logarithms and geometry, and a certain amount of practice in linear drawing. Pupils must be over fifteen. Hospitants must give proof of possessing the preliminary knowledge requisite to thoroughly understand the subject taught.

The curriculum consists of two courses:—*First course*: Mathematics, four hours weekly; designing, eight hours weekly in winter and ten in summer. *Second course*: Elementary mechanics, differential and integral calculus, physics, mechanical engineering and designing. There are for both courses two hours of daily practice in the workshops, except on Saturdays. There are twenty-five pupils, paying each twenty florins annual school-fee.

Prof. Koristka, in his account of the Polytechnic Schools of Bavaria, takes the following notice of the workshops at Augsburg:

Although in general the establishment of machine-shops at the Polytechnic schools has been given up for want of success, as at Dresden, Berlin, Carlsruhe, Zürich, &c., we must confess that these workshops have had marked success at Nuremberg and Augsburg. The instructive and beautifully-made models of Augsburg are to be found in almost every collection of models in Germany, and the Principal of the Augsburg workshop (Prof. Walter) has for years devoted all his energies to this branch of instruction. To give a little idea of the way in which this instruction is given, we add the plan, condensed as far as possible, as it was explained to us by Prof. Walter. During the first year, two hours daily are spent in the workshops; during the second year, one hour daily; in the third year three, and that from 4 to 7, after the theoretical instruction. The most of the scholars have never had any practical experience. The scholar is placed at a screw, a coarse file and a piece of (smith's) iron are given him. He is to practice himself in filing first planes at right angles and then parallel to one another. Then he is made to do the same with a finer file. Nothing can be done superficially, and no pupil is allowed to go on until he has been thoroughly successful. Then the scholar is practiced in boring, in cutting of screws, and in making faucets. Then comes the turning of round surfaces and of screws, the smoothing off, &c., and this is all done with simple pieces of iron, out of which different articles, such as paper-weights, &c., are made. The next tasks given are the completion of correct rulers, simple steel angles, turners' compasses, and so on, until the pupil is able to make a pair of brass compasses, with steel points soldered in. If the pupil can do all this correctly, he is capable of taking a simple model of some motion and working on without assistance. He generally reaches this point during the third course. This instruction is not obligatory, but if a scholar has once undertaken it, he is held strictly to all its duties. Scholars are paid for the models they complete. When they have finished the course they are generally far enough advanced to be able to support themselves by work in any factory. The workshops at Augsburg have twenty-one screws, with a perfect assortment of tools belonging to each, five (foot) turning-lathes, and a great lathe more than twenty feet long. Besides this, there are joiners' benches, two planing machines, a large and two small wheel-cutting engines, a boring machine, a smithy, &c. Many of these things are made here, so that it is impossible to give the cost of the whole machine-shop. The following prices may give a faint idea of the expense: a screw, with its appurtenances, \$52, a turning-lathe and its belongings, \$179, a planing-bench, with its tools, \$50. The common tools used would amount to about \$1,960. The tools for the blacksmith's shop cost \$240. According to this we should estimate the furnishing of similar workshops at about \$4,000 or \$5,000. Beside the scholars, day-laborers also work in these shops, and are regularly paid. In 1860 the expenses for labor, reparations, material, salary of the overseer, &c., amounted to \$959, the receipts to \$976.80.

## POLYTECHNIC SCHOOLS AT MUNICH.

The plan on which the Polytechnic School at Munich is now organized, and the distribution of subjects in the general division of mathematics and natural sciences, and the four special divisions or schools of architecture, mechanical engineering, technical chemistry, and of trade and commerce, has been so fully set forth in the general exposition of the system of technical instruction as established by the law of 1864, that any further description here is unnecessary except to give a few particulars from the last prospectus.

The conditions of admission are, the necessary preliminary knowledge, and good moral conduct.

The pupils of the general division are bound to take part in the lessons on at least five subjects in each semester.

The pupils in the special divisions are bound to take part in all the studies mentioned in the programme of the division.

Admission into the Polytechnic School is only granted to those who can produce a certificate of having passed the absolutorium of a technical gymnasium, or who will submit to examination in all the subjects of study pursued in those institutions.

Admission to pupils or hospitants, who wish to attend only some particular lessons, is, however, granted on less difficult conditions.

On entering the Polytechnic School, regular pupils and hospitants must pay an admission fee of 5 florins.

The school honorarium is 20 florins per semester. Hospitants pay 4 or 6 florins, according to the number of lessons they take weekly.

For participation in the work of the laboratory, pupils pay 15 florins, and hospitants 20 florins.

Individuals giving proof of special worth and abilities, and at the same time of incapacity to pay, may be absolved from payment of the above fees.

An absolutorial examination is held at the close of each school-year, the subject of examination being fixed by the professors in council.

The premises heretofore occupied are spacious, and the equipment every way suitable; the lecture and class-rooms are large and well lighted, and the laboratories for the chemical students afford every convenience for manipulations. The rooms for drawing are well provided with models, and the collections of all kinds for illustrations in architecture, mechanics, and engineering, are large, and of the most recent construction.

To these facilities for instruction within its own premises, this great technical school can hold out to the student the splendid galleries of art, the vast collections in natural history, the well-equipped and officered laboratories of the Conservatorium, and the great industrial establishments generally of Munich, which are now commanding a patronage fairly won by the scientific and artistic training which the foremen and workmen generally have received.

The General Conservatory of Scientific Collections at Munich embraces twelve distinct collections, viz.: the cabinet of coins; the antiquarium; the observatory and meteorological institutes; the chemical laboratory; the mineralogical, geological, zoölogical, and paleontological collections; a botanical garden, and an anatomical institution. The Conservatorium has an income of 50,000 florins.

The Academy of Sciences, originally founded by the Elector Maximilian III, but reorganized by King Louis and placed in immediate connection with the University; the Royal Library, with over 800,000 volumes, and the University Library of 160,000 volumes; the School of Mines, the Cameralistic studies, or science of finance and public economy; the general artistic and scientific pursuits of Munich—make it desirable as a place of higher scientific study.



## ACADEMY AND SCHOOLS OF THE FINE ARTS.

Within a very recent period, Bavaria has become one of the great art centres of Europe, and its capital, which has increased in population from 20,000 in 1805 to 155,000 in 1868, not only possesses in its galleries and collections valuable remains of ancient art, and the modern productions of other countries, but is rich in specimens of architecture, painting, statuary, castings, and frescoes, executed by her own artists trained in her own schools and ateliers. The late King Louis expended on buildings and works of art in Bavaria over \$80,000,000. This expenditure was not confined to the fine arts, in the construction, ornament, and equipment of public buildings, and galleries for the possession and enjoyment of the few, but was intended and felt in its beneficence throughout all the mechanical industries, and by every class of the kingdom.

## ROYAL ACADEMY OF THE FINE ARTS.\*

For the youth who has determined to embrace the career of an artist, the Royal Academy of the Fine Arts offers the requisite means of completing his education. This institution has its origin in the drawing-school founded by the Elector Maximilian III, in 1770, and reëstablished by King Maximilian the First, in 1808; but its present flourishing condition is the work of King Louis, who gave it a new constitution in 1846. It is at once a society of artists and a school of art.

The instruction given in the academy is both practical and theoretical. The former embraces historical painting, sculpture, architecture, and copper-engraving; the latter, the history of art, anatomy, perspective, descriptive geometry, and shading. The common basis of artistical studies is considered to be drawing after the antique; but especial attention is also directed to the drawing, modeling, and painting after nature. The instruction in historical painting is given in four separate schools, each under the direction of a distinct professor. There are also separate schools of sculpture, architecture, and engraving. Lectures are delivered regularly on the history of art, ancient and Christian, as well as on anatomy, and on the other branches of theoretical knowledge.

The admission to the academy is free both to natives and foreigners, provided they are qualified by the possession of adequate elementary knowledge and facility in the higher branches of drawing, with a proper scholastic education, and a good moral character. The pupils destined for architecture must, if natives, have passed through the polytechnic school; and if foreigners, produce certificates of their mathematical attainments. The candidates execute an experimental performance, upon the result of which their admission depends; and they must, further, remain a half-year on probation before they are definitively enrolled as pupils. The maximum period of study in the academy is six years, but pupils may leave it earlier if qualified. Diligent and talented pupils, who are natives of Bavaria, and poor, may obtain small stipends, besides being furnished gratuitously with models for the cartoons, pictures or statues which they may execute within the academy.

A general exhibition of modern works of art takes place about every three years, under the direction of the academy.

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\* Abridged from Report of J. Ward, Secretary of the English Legation at Munich.

The academy has also the execution or direction of all public works within the sphere of painting or sculpture. It forms a kind of council to the King in all matters of art.

The staff of the academy consists of a director, (for many years the celebrated Kaulbach,) five professors respectively of painting, sculpture, architecture, engraving, the history of art, and the technics of painting, with teachers of anatomy and of perspective, descriptive geometry, and shading, and a corrector of the pupils' performances, a teaching force of fourteen persons. It has a secretary, an inspector, and proper attendants.

The usual number of pupils is 230, among whom are several foreigners.

The annual expenses of the academy itself amount, in the whole, to 22,816 florins, or £2,281 sterling—a very moderate sum, considering the efficiency of the institution and the merits of the professors. The budget of the academy, however, in the government estimates, comprises the annual charge of the public galleries, &c., and stands thus for 1864:—1. The Academy of the Fine Arts, 22,816 florins; 2. Galleries of Art, the property of the State, (viz., the Glyptothek, Pinacothek, New Pinacothek, &c.,) 20,501; 3. Working artists, 1,800; 4. Allowances and pensions to artists, 6,721; 5. Cashier's department, 500; 6. General Reserve Fund, 357. Total, 52,745 florins, equivalent to about \$21,000.

There are other institutions in Munich which the inhabitants themselves have formed for the furtherance of the same objects, such as the Art Union, the Trades' Union, and the like. The Society for the Improvement of Manufactures has, in particular, had a very useful tendency, by the constant communications which it keeps up between the class of artists and that of mechanics. It was founded in 1850, and the chairman is the eminent architect De Voit. The society gives to its members drawings and models for all articles to be worked or manufactured in the department of industry, arranges occasional exhibitions, and publishes a journal. Whilst the artist furnishes the drawings or designs, the artisan is often able to give useful suggestions with respect to the materials best suited for the work; and so both the one and the other is mutually improved. The progress which has been made in casting, and other branches of metallic work—of which the late Paris Industrial Exhibition has furnished evidence—is considered as in some measure attributable to this society, which aims at raising the character of manufacturers, by bringing them more closely into contact with the fine arts.

The number of artists constantly residing in Munich is very large, and is stated to be about eight hundred. They are chiefly Germans, but artists from foreign countries are also continually visiting the Bavarian capital. The daily association of these persons with each other can not fail to be attended with beneficial results. Not only is the principle of emulation called into action, but ideas are exchanged in a social intercourse which often lead to the realization of important works. Munich offers, in this respect, on a small scale, the same advantages that Rome does on a larger. Nor are the artists by any means confined to their own set. They mix pretty freely with other classes of society—with learned men, tradesmen, mechanics, and artisans; and hence their tendency has become more scientific than formerly; they have become more disposed to avail themselves of practical science in the execution of artistic works. This improvement is partly attributable to the influence of the polytechnic school,



As a school of pure art, there is no place out of Italy which holds out so many attractions to the student. He finds in the Glyptothek, the Pinacothek, and the other Royal collections, the best opportunities of copying from the antique, and of forming his knowledge of the painting and sculpture of more modern times. He sees around him magnificent public buildings, and churches whose architecture is only surpassed by the beauty of their internal decorations.

ROYAL SCHOOL OF ARTS APPLIED TO TRADES, AT NUREMBERG.

The Royal School of Arts applied to Trades (*Kunstgewerbschule*) at Nuremberg aims not only to promote art, but to improve the artistic character of industrial products. It receive pupils above sixteen. The curriculum is as follows:

*Division I*, (12 hours a week to each study.)—1. Drawing from ornamental models; 2. Practice in architectural drawing, with theoretical lectures; 3. Drawing from antique models; 4. Modeling and drawing ornaments and figures.

*Division II*.—1. Painting, drawing, and modeling from life, for artists; 2. Plastic studies for artists; 3. Exercises in composing and executing subjects in figures and of an ornamental character; 4. Embossing and sculpture; 5. Wood-carving, exercises in carving ornaments and figures, and execution of objects of industrial art; 6. Brass-founding—exercises in forming, founding, and engraving.

*Supplemental classes*, (2 hours weekly to each branch.)—1. Perspective and shadows; 2. Anatomy.

The practical branches, such as architecture, sculpture, and ornamentation, are made the chief subjects of instruction, and are taught with special reference to the present requirements of industry.

The general opinion of the persons who have made a study of questions connected with teaching, not only in Bavaria, but also in other parts of Germany, is that the Nuremberg school has contributed more than any other to the progress of the national industry. This progress is especially manifest in the very decided improvement in the manufacture of children's toys, which are one of the staple productions of the country. For some years past, the improvement in the forms of the articles, whether molded in clay or sculptured in wood, with which the Nuremberg manufacturers supply the shops of Paris, has shown us that great progress must have been made in the teaching of drawing, and ample confirmation of this opinion may be obtained on visiting the higher drawing-school of this town. The Parisian manufacturers, though superior in other matters dependent on the arts of design, are, with regard to children's toys, very inferior to the Nuremberg artisans.

SPECIAL SCHOOL OF INDUSTRIAL DRAWING AT NUREMBERG.

In this town, so noted for its various manufactures, there are several drawing-schools of different degrees, according to the trade the pupils intend to follow. The first and most important is the higher school of industrial drawing conducted by M. Kröling. It is justly regarded in Germany as the one which has rendered most services to industry. In order that the pupils may, in a few years, acquire some real skill, none are admitted but those who have already attained considerable proficiency. The principle adopted by the professor of this school is that, in order to form good industrial draughtsmen, the pupils must pass through all the degrees of artistic drawing, so that they may be able,

in the very varied and different combinations required by manufacturers, to blend judiciously and harmoniously all the various kinds, without there being any necessity, as often happens, for having recourse to one artist for the architectural part, to another for the figures, and to a third for the ornaments, &c.

As for the method of teaching, it is exclusively based on drawing from models in relief, graduated according to the proficiency of the learners, and advancing from the simplest models to the finest left by ancient art, and then to nature. The talented director expresses his antipathy to copying from lithographs, which he regards as calligraphy, not drawing. In accordance with these principles, he has formed for his pupils very fine and very complete collections of models. The teaching is distributed in three divisions:—1, drawing of ornament; 2, drawing from the antique; 3, drawing from nature. After attaining proficiency in drawing, the pupils pass on to modeling and sculpture in wood and stone; then, as soon as they have attained a certain degree of skill, they have to compose designs, and to model and carve them.

As a preparation for the higher drawing-school, there is an elementary school with courses occupying two years. The first, of eight hours' lessons per week, is entirely devoted to free-hand drawing, beginning with exercises on straight lines and curves, on plane surfaces, on symmetrical and regular bodies, and on simple and complex ornaments, finishing with compositions. The second course, of six hours per week, is devoted to drawing ornaments, to drawing from the round, from the antique, and also to drawing furniture.

#### INSTRUCTION IN DRAWING.

The instructions drawn up in the Department of Commerce and Public Works, for the government of the newly-organized technical schools, mark out a detailed course for drawing founded on the long experience of the famous schools of Nuremberg and Munich.

#### PROGRAMME FOR DRAWING IN TRADE-SCHOOLS.

COURSE I.—*First half-year*.—Exercise of eye and hand in drawing lines and geometrical figures; delineation of objects of suitable size, and with plane surfaces; explanations of the nature of vision, and with this the first elements of perspective; linear drawing without instruments should be combined with free drawing, (*Freihandzeichnung*.)

*Second half-year*—Continuation of the free drawing; delineation of simple ornaments from cartoons, or from plaster models, in slight relief or perforated; linear drawing, with the aid of compasses and mathematical instruments; drawing, division and measurement of straight lines, right angles, and figures; construction of scales, measurement, &c.

COURSE II.—Free drawing of more elaborate ornaments from plastic models; the proportions of the human head and its various parts, from simple outlines; exercises in the construction of regular curved lines, architectural members, projection of simple surfaces, and of regular equilateral figures; embossing from simple plastic models in different sizes.

COURSE III.—Continuation of exercises in free drawing from the round; delineation of animals and plants, in as far as these may be applicable to ornamentation, with slight indication of shades, so as to make the form distinct; explanation of style; delineation of the human body, and its proportions, in outline; linear drawing; continuation of exercises in designing simple machines and models; the five orders of architecture; industrial tools; profiles, &c., as far as possible in natural size, from models; sketching from nature; exercises in drawing with Indian ink; slight coloring of profiles, &c.; embossing from drawings of simple classical artistic forms.



*Modifications for the Agricultural Division.*

COURSE I.—*First half-year.*—[Substantially the same as in the trade course.]

*Second half-year.*—Linear drawing, with help of compasses and mathematical instruments; drawing, dividing, and measuring straight lines, plane angles and figures, and construction of scales of measurement; exercises in drawing plans and elevations of simple geometrical bodies, in various positions, and in the rules of the theory of proportions.

COURSE II.—Exercises in drawing plans and elevations of separate architectural parts, more especially of the stationary arrangements of farm-buildings, from models, and also from nature; delineation of simple agricultural implements; first rules of plan-drawing.

COURSE III.—Exercises in drawing entire buildings from models on a different scale of measurement; delineation of ground-plans, elevations, and sections; delineation of more complete agricultural tools and machines without models.

## PROGRAMME FOR REAL-GYMNASIUMS.

COURSE I.—Free drawing; exercises in drawing straight lines and geometrical figures formed by them; delineation of bodies with plane surfaces, with explanations of the nature of vision, and of the most simple phenomena of perspective, illustrated by single objects, or groups of objects, of suitable size; exercises in drawing curved lines and simple ornaments formed of these; outline delineation of symmetrical ornaments and vessels from cartoons and plaster casts in slight relief, of simple antique artistic forms.

COURSE II.—Free drawing; division and proportion of the separate parts of the human frame drawn from cartoons; foreshortening of the several parts in different positions, then of the whole body, using the geometrical lay figure as a model; more elaborate ornaments in outline from embossed and plane models; exercises in the use of rules, compasses, and other instruments, by delineation and division of plane figures; explanation of the planes of projection; exercises in the delineation of simple bodies by means of their projections, with use of the prismatic compass when copying from cartoons; measurement and projection of solid models in different positions, and according to different scales of reduction.

COURSE III.—Simple exercises in shading, at first from models of plane ornaments, afterwards from ornaments in relief; drawing of heads, hands, and feet in different positions, from slightly-executed models; ornaments belonging to various periods of art, as much as possible in connection with architectural features; measurement of complex solid models with plane surfaces, and projection of the same according to the rules of descriptive geometry, and to a given scale of reduction, and in a prescribed position; modeling of ornaments in relief, first from solid models, and then from plane patterns, and on a different scale.

COURSE IV.—Delineation of animal and vegetable forms, if possible, from models in relief, and with strict attention to foreshortening and bends; elucidation of styles and exercises therein; delineation of figures from simple plane models; ornaments in combination with human and animal forms, from the plane and from the round; projection of solids with curved surfaces and their intersections (*Durchdringungen*;) delineation of the different orders of columns from cartoons; exercises in linear perspective and shading.

## DRAWING IN THE COMMON AND SPECIAL SCHOOLS.

Drawing is made obligatory in all the higher classes of the popular or common school, but it is more systematically attended to in the *Further Improvement School*, and in the special drawing-schools, of which there are now 261, in which are employed 270 well-trained teachers, with an aggregate attendance of over 7,000 pupils. Of these institutions, 219 are public, and 121 independent; 140 united with other institutions. There is in Munich a special drawing-school for women.

## PUBLIC PROVISION FOR INSTRUCTION IN MUSIC.

Great attention is paid to musical culture, not only in the capital, and chief cities, but throughout the kingdom. It is made obligatory in all common schools, and ability and success in its instruction is secured by ample provision in the training of teachers, and in a rigorous examination on this point of all candidates. Mr. Julius Eichberg, director of musical instruction in the Girls' High and Normal School in Boston, in a recent (1868) communication addressed to Dr. Upham, Chairman of the Committee on Music in the Boston Public Schools, respecting the manner and extent of popular musical instruction in certain European cities, remarks: "In no part of Germany does music receive more attention than in Bavaria and in Bavarian schools."

## MUSICAL STUDIES FOR PUBLIC SCHOOL TEACHERS.

By royal decree, dated September 29, 1866, concerning the education of school teachers, their musical studies, which are continued through the three years of the seminary course, are fixed as follows:

1. *Primary School Teachers.*

FIRST COURSE.—(A) *Singing*.—General rules for the cultivation of the voice, breathing, position of mouth and body. Practice of major and minor scales, general musical theory, practice of intervals and singing of short songs within the diatonic scale.

(B) *Piano*.—Knowledge of the key-board, notes and measures, five notes finger exercises, easy major and minor scales.

Books to be used:—*Piano Method*, by Wohlfahrt, Part I; finger exercises by A. Schmidt; one hundred exercises by Czerny, and Enkhausen's first Beginning.

(C) *Violin Playing*.—Position of the body. Practice of scales and intervals.

Book used:—Hohmann's *Violin School*, Part I.

SECOND COURSE.—(A) *Singing*.—Practice of more difficult intervals. Use of accidents. Singing of two-part songs, for soprano and alto. Attention to be given to correct breathing.

(B) *Piano*.—More difficult scales in two octaves, continuation of Czerny's one hundred exercises and Wohlfahrt's *Piano method*. Sonatas by Mozart and Haydn.

(C) *Violin*.—All the scales in Hohmann II.

(D) *Harmony*.—Intervals. Theory of consonances and dissonances. Major and minor triads and connection of the same. Playing the perfect cadences by heart, in every way.

THIRD COURSE.—(A) *Singing*.—The preceding exercises have enabled the pupils (unless hindered by mutation of voice) to assist in the church choirs.

For Catholic institutions the practice of easy Latin or German masses is required; for Protestant institutions the practice of easy motets by Rink or Drobisch, as also the chorals of moderate difficulty from the *Bavarian Church Melody Book*, by Zahn.

(B) *Piano*.—Practice of Bertini op. 29, running passages by Czerny, sonatas by Haydn, Clementi, and Mozart. Four-hand exercises by Bertini.

(C) *Organ*.—Explanation of the pedals and the various stops. Practice of simple cadences.

Book used:—Rink's first three months on the organ.

(D) *Violin*.—Progressive practice of exercises and duets. Hohmann's *Book III*. Practice of violin—parts from works by Michael Haydn, Mozart, and others.

(E) *Harmony*.—Inversion of triads and their connection with triads. Chords of Seventh. Book used, Förster's *Examples I*. The conducting of church music being among the duties of school teachers, pupils of the preparing school should now get acquainted with the use and nature of the several stringed and



wind instruments, as afterwards, when in the seminary, but little time can be given for this purpose. Nevertheless, the study of these instruments is not obligatory on the pupils.

### 2. Plan of lessons for the Preparing School.

COURSES I AND II.—Religious instruction, 3 hours per week; German language, 6; arithmetic, 4; geography, 2; history, 2; natural history, 2; calligraphy, 2; drawing, 2; music, 6. Total, 29 hours.

Religious instruction, the study of the German language, of arithmetic, and of music, are considered the principal branches, insufficient progress in either of which entails with it the repetition of the course. But if insufficiency in music is owing to lack of talent and not of industry, no repetition of the course is necessary.

### 3. Seminaries for Teachers.

COURSE I.—(A) *Singing*. (a) *Catholic Seminaries*.—Theory of choral singing. Practice of psalm melodies, antiphonies, and other Church songs. Practice of one-part chorals, with the organ accompaniment played by the student.

(b) *Protestant Seminaries*.—Learning by heart of chorals, from the Bavarian Choral Book for the Protestant Church. Zahn's harmonization of chorals, for male voices; also, the four-part songs, by J. Rietz.

(B) *Piano*.—School of velocity, by Czerny. Organ lessons to be prepared on the piano.

(C) *Organ*.—Review of the lessons from the preparing school. Use of pedals. Preludes, by Rink and others. Protestants to practice the whole of the Bavarian Melody-Book, as also preludes by Herzog and Ett.

(D) *Violin*.—Hohmann, Book IV. Review of previous studies. Practice in orchestra-playing.

(E) *Harmony*.—Theory of connected chords of the seventh and their inversions. Prolongations, their inversions. Organ-point. Playing of figured basses. Förster's Examples B, II and III.

COURSE II.—(A) *Singing*.—*Protestant Seminaries*.—Church Songs of the 16th and 17th centuries, by Zahn. Volks-Klaenge, for male voices, by Erk. Sacred choruses, for male voices, by W. Greef.

(B) *Piano*.—To be considered as a preparatory study for the organ. The more advanced students to practice sonatas, by Beethoven, and Clementi's Gradus ad Parnassum.

(C) *Organ*.—*Protestant Seminaries*.—J. S. Bach's chorals, for four mixed parts, as preparation for the more difficult preludes. Study of the longer preludes and chorals, by Herzog and Ett. Extemporaneous preludes. System of ancient tonalities.

(D) *Violin*.—Hohmann, Part V. By diligent practice the student ought to acquire the capability of playing the first violin part of orchestral works, by Haydn and Mozart, correctly.

(E) *Harmony*.—Theory of modulations, demonstrated by the student, both in writing and at the piano. Four-part harmonization of chorals, or other given subjects. The study of the other instruments, without being obligatory, is advisable. The most advanced students are to practice orchestra-playing once a week. The practice of so-called brass music is forbidden.

Religious instruction, German language, arithmetic, mathematics, theory of teaching and music, are to be considered the principal branches; the other branches secondary.

The following is the division of hours in the Royal Bavarian Seminaries for Teachers, both courses being equal:—Religious instruction, 3 hours per week; German language, 4; arithmetic and mathematics, 3; geography, 1; history, 2; natural history, 2; science of teaching, 5; natural philosophy, 2; drawing, 2; music, 6. Total, 30 hours per week.

The following is a schedule, to be filled up at the annual examinations:

<i>Natural Disposition.</i>	<i>Moral Conduct.</i>	<i>Industry.</i>	<i>Progress.</i>
I. Very great.	Very praiseworthy.	Very great.	Very great.
II. Great.	Praiseworthy.	Great.	Great.
III. Sufficient.	Satisfactory.	Satisfactory.	Satisfactory.
IV. Little.	Not free from blame.	Unsatisfactory.	Unsatisfactory.

According to section 75, students applying for situations as school teachers, must have received at least No. III, for their musical qualifications.

#### PUBLIC MUSIC SCHOOL IN WÜRZBURG.

In all the Bavarian cities where school seminaries are established, there exist, as branch establishments, public music-schools, where the seminarists receive their musical instruction. These music-schools are, like the seminaries, under the supervision of the Minister of Public Instruction in Munich, and an annual sum is provided by the budget for their maintenance. The Royal Music School in Würzburg is the oldest of these institutions, having been founded on the 18th of April, 1804, since which date it has given a sound musical instruction to countless school-teachers, and in consequence has vastly advanced the cause of music in Bavaria. Although designed at first as a branch to the Würzburg Seminary, it has long since outgrown these limits, and has become one of the most prominent of German musical high-schools, from which numbers of eminent men have graduated in succession. The founder and first Director was the celebrated Dr. Joseph Fröhlich, professor of æsthetics at the Würzburg University, one of the profoundest musical theorists of the century. After his death, in 1862, he was succeeded by the present Director, Mr. T. G. Bratsch, to whose kindness I owe a host of interesting facts concerning the good work that is being done in the Bavarian schools.

In these schools singing is not merely tolerated, but forms a principal part in the common-school education. Pupils are not permitted to show a listless, indifferent manner at their music lessons, but are made to understand that this branch of education is considered by the school authorities as equally important with the 'three R's,' as we call them. Select voices from the public schools are occasionally allowed to join the seminarists in the performance of some important musical work, such as cantatas and oratorios; and I have before me the programmes of Pierson's oratorio, 'Jerusalem,' and Spohr's oratorio, 'Our Saviour's Last Moments,' performed solely by the seminarists and select pupils of the public schools, including solo parts, choruses, and the full orchestra.

I was present, by invitation, at the musical examination of aspirants to the seminary, and when it is taken into consideration that it comprised singing, organ-playing, violin, and piano, some shortcomings in any of these branches will not be wondered at. The choral and orchestral forces of the music-schools (composed, as above stated, of seminarists and pupils of the public schools,) meet, assisted by the music-teachers, twice a week for the practice of oratorios and symphonies. The public are admitted to these exercises without charge or any formality whatsoever. The exercises are conducted alternately by the most advanced students, under the supervision of Mr. Bratsch.

No musical text-books are in use in Bavarian schools, but the teacher uses the blackboard for the theoretical instruction, and for choral practice in addition to the publications of L. Erk and Greef, selections from cantatas, motets or masses within their reach.

#### CONSERVATORY OF MUSIC.

The Royal Conservatorium of Music at Munich has a director and 14 teachers, with an average of over 100 pupils, and receives aid from the government to the amount of 8,000 florins.



## INSTRUCTION IN AGRICULTURE AND RURAL ECONOMY.

The establishments for instruction in agriculture consisted till 1864 of three central schools of agriculture, forestry, and veterinary science, and an agricultural course or special divisions in the trade schools. Of these last there were thirty in 1864. Since then several of them have been discontinued, and the whole system has been reorganized as follows:

## CENTRAL HIGH SCHOOL OR INSTITUTE OF AGRICULTURE.

The Agricultural Institute was established in 1835, in the royal domain of Weihenstephan, in the old town of Feising, twenty miles north of Munich.

The grounds include nine hundred and thirty-eight acres of arable and pasture land, as well as of forest, with an immense building, standing on a gentle elevation which overlooks a wide extent of beautiful country. The building forms a series of parallelograms, inclosing a great grassy court, and providing for the laboratory, collections and cabinets of various kinds, halls of study, dormitories, &c. Around a second court are the cattle barns, and other structures.

The live stock comprises all kinds of domestic animals, and there are also:— Experimental fields for various cultures. A brewery and distillery. A nursery. A hop ground. A cheese dairy. Technological collections. A chemical laboratory. A collection of various seeds. A collection of the productions of the Bavarian soil. A cabinet of instruments for experimental physics. A collection of agricultural implements and models. A library. A plantation of mulberry trees for the study of silkworms. An anatomical collection for veterinary studies. The neighboring forests offer opportunities for the study of resinous trees.

The instruction is distributed as follows:—

**FIRST YEAR.** *Winter Term.*—Agricultural implements. Experimental chemistry. Arithmetic. Elements of construction. Drawing of plans and farm implements. Physiology of plants, agronomy, agriculture. Forest science. Anatomy, physiology, and dietetics of domestic animals.

*Summer Term.*—Practical farming. Experimental chemistry. Construction. Drawing of plans, surveying. Breeding of cattle, races, diseases. Physiology of plants. Agronomy. Agriculture. Forest management.

**SECOND YEAR.** *Winter Term.*—Organization of rural economy and management. Agricultural chemistry. Roads. Drawing of plans and farm implements. Breeding of cattle. Veterinary police, warranty of cattle sold. Physical geography. Meteorology. Climatology.

*Summer Term.*—Valuation of farm property, and book-keeping. Agricultural chemistry. Farm buildings, meadows, and draining. Agricultural technology. Breeding and rearing of cattle. Veterinary police, warranty of cattle sold. Physical geography. Meteorology. Climatology.

The studies last two years, and the instruction is given by nine professors and two assistant professors. The youths who attend this school are divided into two classes, ordinary pupils and free auditors. There are about twenty of the former and forty of the latter. To be admitted, the candidate must have attained sixteen years of age, have followed the studies of an agricultural school (*Landwirthschaft Schule*) or of a trade school; he must also know enough Latin to understand the value of the terms borrowed from that language, and be able to undergo an examination on the subjects taught in those schools.

Owing to local circumstances the pupils are, contrary to the general usage in Germany, received as boarders; Bavarian subjects for one hundred and twenty-five florins per half year, and foreigners for one hundred and fifty florins. This charge includes teaching, board, and lodging; books and school necessaries the pupils find themselves. They also have to pay two florins per half year for the reading room. The free pupils pay thirty-five florins per half year for each course they follow, and may obtain a certificate relative thereto. The courses begin on the 1st of October and end on the last day of August, with a fortnight's vacation at Easter. At the end of the year, examinations are held, and the deserving pupils receive certificates of aptitude.

Mr. C. L. Flint, secretary of the Massachusetts board of agriculture, in a report of his visits to several agricultural institutions abroad in 1863, thus speaks of Weihenstephan:

I arrived there from Ratisbon on a bright summer morning, introduced myself to the first man I met, told him my object, and learned at what hours the various lectures took place, attended two or three of them and became acquainted with the professors, visited and examined the collections, the stables, the brewery, the farm and experimental field, the sheep, &c.

The estate lying in connection with this institute comprises, I believe, about six hundred and fifty acres, of which there are usually about eighty in wheat, over forty in rape and root crops, about thirty-five in oats, twelve to fifteen in potatoes, fifteen to twenty in rye, eighteen to twenty in barley, eight to ten in beans, five in hops, about one hundred and thirty in fodder crops, such as lucerne, clover, vetches, &c., while about one hundred and fifty are in mowing fields and so on. The land is of excellent quality.

The stock consists of twelve horses, twenty-two pairs of oxen, fifty-nine milch cows, seven young cattle, thirty swine, and five hundred and seventy sheep. The cows are mostly of the Allgäuer and Mürzthaler breeds, which are considered best for milk after the Dutch. The cross with the Allgäuer and Swiss, they say, makes fine working oxen.

The buildings form a series of parallelograms, inclosing a great grassy court, around which are arranged the various departments, as the chemical laboratory, the rooms for study, &c. Around a second court are the cattle barns, the dairy and stables, the granary, the brewery, the plough manufactory, &c. There are also various other establishments, a distillery, a flour mill, &c.

The number of students is about seventy. The course of instruction does not materially differ from that at Hohenheim.

During the summer term, for instance, there were lectures by the Director, on soils, their origin, the different kinds of soil, weathering, irrigation, drainage, division and natural classification; the comparative value of soils for the production of plants; circumstances which modify this value; the soil differs according to the coarseness of its particles and its tenacity; sand, loam, clay, marl and humus; subdivisions of soils; taxation of mowing lands, pastures, gardens, vineyards, swale lands, fisheries, &c.; double-entry book-keeping as a check upon farming operations.

Dr. Riederer lectured upon the following topics:

1. Introduction to agricultural practice, idea and object in general and the systems of Thaer, Thünen and Liebig.
2. The positive and negative means of a good farm management, as the judicious division of land, proper number of laborers, education of the farmer, necessary capital, &c.
3. Advantages and disadvantages of large and small estates. Influence of a judicious regulation of the corn trade, at home and abroad, on the profits of farming, &c.
4. The most important directions in regard to keeping animals and the proper estimation of their products.

Text-books are used in connection with the lectures.



Professor Knobloch lectured three hours a week upon—

1. Agricultural Chemistry.—Chemistry of fermentation, decomposition, formation of humus. The chemical contents of manure, excrements of birds, solid and liquid excrements of man and animals, strawy materials, disinfection. The chemical principles of the preparation of composts. Bone manuring, phosphorites, and koprolites, gypsum, wood and peat ashes. Manuring with oil-cakes, ammonia, and nitric acid salts. Fish guano. The formation of soil through the culture of agricultural plants. The chemical principles of fallowing and rotation. Drainage. Chemical analysis of soils and kinds of manure, the ashes of plants, of spring and running water, and of different agricultural products. On Liebig; chemistry in its application to agriculture and physiology, &c.

In connection with these lectures, the chemical laboratory was open daily during the term, and the students worked industriously in it, in making analyses of soils, manures and ashes, milk, potatoes, feeding materials and cereals, sulphuric acid and phosphoric acid determinations, &c.

2. Agricultural Technology.—Four hours weekly. Fermentative processes of the beer brewery, the brandy distillery and vinegar manufactory in its whole range. Making of butter and cheese, making of starch, and the application of the latter to the production of sago. Lime and brick burning. Turf cutting.

*Technological Practice*, four half-days a week in the winter term, and one half-day in the summer term. Manufacture of Bavarian normal and strong beer, potato, grain and maize brandy, vinegar, starch, &c. Demonstrations in the brandy distillery, the cheese dairy, the brickyard, at the limekiln, and on the turf or peat meadows. Investigation of various raw materials and fabrics. Agricultural technological mechanics. Excursions to farming estates in the neighborhood.

Professor May gave lectures in the winter term, five hours weekly, upon—

1. The anatomy of the horse, the sheep and the swine, with demonstrations by skeletons and preparations.

2. Physiology of domestic animals, in connection with the feeding proper for them.

3. The races of the larger farm animals. Study of the different races, breeds and families of improved domestic animals, their form, characteristics and useful qualities.

4. General principles of the production of animals. Methods and principles of breeding. Green, dry, root, bulb and corn fodder. Wastes of the farm. Loss and injury from particular feeding materials. Comparative composition of different materials, and their nutritive value. Preservation, economy and production of fodder.

*Summer Term, four hours a week.*—1. Swine-breeding. Choice of animals. Pregnancy and care of the litter. Parturition. Treatment of the dam and pigs. Close confinement. Keeping at pasture. Fattening.

2. Horse-breeding. Study of the subject from an agricultural and a national economical point of view. Choice of draught horses. Pairing. Treatment of the mare in foal. Handling of colts during the first, second, third and fourth years. Checks in the development.

3. Knowledge of wool. Its normal and abnormal conditions.

4. Importance of a knowledge of veterinary science in the treatment of domestic animals.

SECOND COURSE. *Winter Term, four hours a week.*—1. On wool (continuation.) Wool staple. The wool fleece. Evenness of wool. Cloth and combwools. Working of wool.

2. Sheep-breeding. Choice of animals. Numbering and classification of sheep. Treatment of ewes in lamb. Time of lambing. Management of the young. Pasturing sheep. Washing and shearing. Sorting of wool. Treatment and sale of wool. Fattening. Valuation of the fodder used in sheep husbandry.

3. Cattle-breeding. Choice and selections of animals for breeding. Deviations from the normal presentation. Suckling and artificial raising of calves, General management in all cases.

4. External diseases of the larger useful farm animals.
5. Shoeing. Treatment of the ordinary breaks and diseases of the hoof.  
*Summer Term, five hours a week.*—1. Cattle-breeding (continued.) Stall and pasture treatment. Use of cattle—milk, fattening and draught. Valuation of fodder to be used.
2. Knowledge of the exterior of the horse.
3. Knowledge of the exterior of cattle.
4. Internal diseases of domestic animals. Contagious diseases and their origin.  
Practical exercises of judging correctly of animals, on the part of the students, also of wool; the true modes of breeding and the diseases of stock are constantly enforced.

Prof. Lidl lectures in the winter term, on—

1. Cursory view of the geognostical relations of Bavaria.
  2. Agronomy. Mold and subsoil, humus, sand, clay, lime, gravel and alluvial soils. Local aspects and their influence on vegetation.
  3. Agriculture. Cultivation—working of the soil by cultivation, by different implements. Improvement of soils.
  4. Anatomy and physiology of plants. Cells and vessels of plants. Difference in them. Contents of cells. Plant-cells in their various relations. Intercellular tissue. Nourishment of plants. Motion of the sap. Production by seeds and spores. Diseases of vegetation.
  5. Morphology. Root, stem and leaf organs, flowers, fruits and seeds.  
*Summer Term.*—1. Special plant culture—grain fodder and root-plants.
  2. Economical botany. The most important weeds and poisonous plants.
- SECOND COURSE. *Winter Term.*—1. Fruit culture.
  2. Cultivation of special plants, root, commercial and coloring plants.  
*Summer Term.*—1. Culture of special plants, grains, pulse and oil fruits. Fodder plants and tubers.
  2. Wine growing.
  3. Continuation of lectures on botany.

Two botanical excursions are made each week in connection with this course.

Prof. Döhlemann lectures in the winter term, on—

1. Applied mathematics. Recapitulation of the most necessary principles of algebra, geometry and stereometry; calculation, division and alteration of surfaces; calculation of the cubic contents of different bodies.
  2. General architecture. Earth and foundation work. Construction of ore pits. Restoration of hewn stone and brick wall work. Stone binding for pillars. Chimney flues, &c.
  3. Practice in drawing. Drawing of situations. Copying and sketching of simple agricultural buildings and parts of buildings. Drawing of agricultural implements and machines.  
*Summer Term.*—4. Continuation of general architecture. Construction of different kinds of vaults; ornamental works; carpenter's work; joiner's and locksmith's work.
  5. Surveying, with exercises in the field. Explanation of the most useful instruments for length and angle measuring. Solution of different problems of practical geometry, on the field and in practice.
- SECOND COURSE. *Winter Term.*—Agricultural architecture. Laying out and construction of houses and stables. Buildings for the preservation of agricultural crops, &c.
  2. Meadow management, with practical exercises. Theory and use of different leveling instruments. Water measuring. Improvements of fields in general. Drainage. Irrigation. Practice in leveling and water measuring.

Professor Meister lectured in the winter term, three hours a week, on

Physical geography, the atmosphere and climatology. The barometer, thermometer, hygrometer, and psychrometer. Effect of clearing off of forests. Relations of temperature to the atmosphere and the earth, and the consequent



distribution of plants. Peculiarities of land and sea climate, and their causes. Winds. Warmth and moisture. Amount of rain, dew, number of rainy days, storms, fall of hail, and their distribution over the year, and the consequent physical characteristics of the soil. Explanation of the century calendar, and of the so-called rules for determining the weather. Temperature of the soil. Observations at different depths. Barometrical and thermometrical measurement of heights. Construction of sun-dials.

Judge Schleisinger lectures in the second course twice a week, in both terms, on the general German agricultural law in regard to the more important private rights and later laws in regard to cultivation.

This course was comprehensive, embracing the general principles of rights, persons and things, and the laws affecting property, real and personal.

The royal master of forests, Bierdimpfel, lectured in the winter term on the introduction to the management of forests, the structure of woods, plants, and their relation to the air, climate and soil, and on the definition of the technical forest expressions.

*Summer Term.*—On forest cultivation, protection of forests. These courses were illustrated by excursions into the neighboring forests.

In addition to the short and frequent botanical and other excursions in the neighborhood, long excursions are made, from time to time, to various parts of the kingdom, the students being accompanied on them by one or more professors. Special subjects are assigned to some one or more of the class on which to write out a detailed report. As an example, the last great excursion which took place previous to my visit was made to Northern Bavaria, to Nürnberg; and so round to Augsburg, to visit the wool market in that city. In the former city, there was at that time a great meeting of Bavarian farmers, for the discussion of agricultural topics; an agricultural convention, in other words. That was taken into the trip. That part of the kingdom, as well as Franconia, through which the direction lay, is largely devoted to the culture of hops. Now two of the students were appointed to write out an account of the journey in general; three to write on the culture of the hop; two on fruit culture, as seen in the excursion; another on irrigation; another on garlic-land; another on the art of manuring; four others on cattle; two others on the visit to Lichtenhof Agricultural School; another on bees; two others on the wool market; &c. A full report of the excursion, mostly written by the students themselves, is printed in connection with the annual report of the school.

The nurseries on the farm are extensive and the sales from them profitable; but probably the brewery is the most profitable branch of the establishment. Here are used more than ten thousand bushels of malt a year. In the year ending with July 1st, 1863, it used 3,668 Bavarian scheffel, or about 11,000 bushels. In the same year over a thousand bushels of potatoes were used in the distillery. There were sold from the nursery, 8,520 trees.

Just before I was there a terribly destructive hailstorm had occurred, and I never saw such magnificent fields of wheat and other grain so completely riddled and ruined. It was painful to look upon. It had given promise of an extraordinary yield up to the time of the hail, but it was very nearly a dead loss when I saw it. A committee of appraisers from the insurance company for crops was on to estimate the damages. The wide-spread system of insurance, of which the institute had fortunately availed itself, saved it from very great loss, which otherwise would have fallen very heavily upon it.

I should add that much instruction is given in the field and the nurseries, in the barn and other parts of the establishment, by practical demonstrations. There is a reading-room, a library, and extensive collections and other appliances.

#### AGRICULTURAL SCHOOL AT LICHTENHOF.

At Lichtenhof, in the neighborhood of Nuremberg, there is a school of agriculture, established by Dr. Weidenkeller, in 1832, as a trade-school with two sections, the other section being devoted to the mechanical arts, with a preparatory course common to both.

The school of agriculture comprises:—1. A preparatory school. 2. A school of husbandry. 3. A school of agricultural science.

1. The preparatory school is intended to receive lads whose education has been neglected, and in it they are taught the following subjects:—Religion, two hours per week; principles of theoretical agriculture, two; practical agriculture, four; arithmetic, four; reading, one; calligraphy, four; German language, four; geography, two; natural history, two; drawing, eight. Total, 33.

2. The school of husbandry is intended to educate farmers, bailiffs, and managers. The instruction occupies a year, and embraces the following subjects:—Religion, two hours per week; German language, four; chemistry, two; arithmetic, four; geography, two; drawing, three; calligraphy, four; theoretical agriculture, six; practical agriculture, four. Total, 31 hours.

3. The school of agricultural science is intended to render young men capable:—1, of managing and cultivating farms of moderate size; 2, of being admitted into a central school of agriculture, or into the Munich Veterinary School. The instruction occupies three years, and there were in 1862–63, thirty-nine pupils of the first, eighteen of the second, and fifteen of the third year; in all seventy-two pupils.

These numbers show that less than one-half of the pupils go through the whole course of studies. The school of husbandry had only two pupils, the preparatory school eight, which makes a total of eighty-two pupils, for whom there are thirteen professors and three masters.

The programme of the school of agricultural science is as follows:—

SUBJECTS TAUGHT.	Hours per week.		
	1st year.	3d year.	2d year.
Religion,.....	2	2	2
Theory of agriculture,.....	5	7	4
Practical agriculture,.....	12 to 30	12 to 20	12 to 30
Zoölogy,.....	2	—	—
General and special botany,.....	2	—	—
Pure mineralogy,.....	—	—	1
Applied mineralogy,.....	—	—	4
Physics,.....	—	3	—
Chemistry,.....	—	2	—
Arithmetic,.....	4	4	—
Geometry,.....	—	2	3
German language,.....	4	4	3
Geography,.....	4	—	—
Free hand and linear drawing,.....	6	4	4
Calligraphy,.....	4	—	—
Anatomy and treatment of domestic animals,	—	—	2

Mr. C. L. Flint thus speaks of his visit to this school:—

This institute is about a mile from Nürnberg towards the south. It was founded in 1832, by Dr. Weidenkeller. The farm, originally composed of sand and gravel, almost barren, was gradually changed into a good soil, now apparently fertile and productive, by the students.



The stately buildings of the institute stand at the right of the entrance, and on the left the botanic garden. The buildings are in a modern style, contrasting strangely with the antique structures in the neighborhood. The dwelling of the inspector is within the college inclosure, as also that of Mrs. Weidenkeller, and just beyond, the dormitories for eighty students, the lecture-rooms, the laboratory, a spacious eating-saloon, which serves also as a work-room, a library and wash-room.

The botanical garden contains all, or nearly all, the agricultural plants, arranged in the Linnæan order, besides many of the more common forest trees. The garden of the institute for the growth of vegetables and fruits also joins the botanical garden. Among the fruit trees stands the monument to Dr. Weidenkeller, the founder. A little way beyond lies the experimental field. The improved grounds near by contain a good nursery of trees. In a little grove on a knoll, a monument is erected to his majesty, King Max. A broad space is devoted to ornamental plants and farm crops. The experimental field is about two acres in extent. There is also a hop-garden on a piece of reclaimed swamp. This piece was improved by the pupils without much cost.

Near the main building stands a second, which contains the collections. They consist of skeletons and anatomical preparations, a crocodile, birds, domestic game and some malformations, several models of systems of irrigation, collections of insects, minerals, &c.

The stocks of bees were presented by Dzierzon, and are therefore of special interest. The mode of operation is easily seen from the arrangement of the hives.

The farm buildings consist of cow and horse stalls, shed and coach-house. There were about thirty cows, consisting of Allgäuers and Simmenthalers, a few Ansbachers and Ellingers. The roof of the cow-house is built of wood, the sides of stone.

The instruction at this institute is not strictly agricultural. Much of it, in fact, has no more bearing on agricultural than on any other calling. Religion, the German language, geography, arithmetic, zoölogy and drawing are prescribed studies in the first year. Agriculture and practical agricultural exercises come in for a share of attention, but they don't seem to be especially prominent in the programme.

The second year is a continuation of the first, with a little botany, geometry, mineralogy and history added, while in the third year, agricultural chemistry, farm accounts, rural architecture, machinery, the anatomy and physiology of animals, veterinary medicine, drawing, riding, fencing, and other practical exercises, come in and add variety.

This institute ranks as intermediate in the list of Bavarian agricultural schools.

#### AGRICULTURAL SCHOOL AT SCHLEISSHEIM.

The school of practical farming at Schleissheim was founded in 1822 as an institute for theoretical as well as practical agriculture, after the model of Hohenheim, but the plan was more fully carried out at Weihestephan, and this institution has been carried on apparently to illustrate the pursuit of agriculture under difficulties.

Mr. Flint thus describes his visit in 1863:—

The estate consists of about six thousand five hundred acres, and like many other establishments of the kind, it possesses a fine old royal residence or chateau, the whole lying in an immense, but not very fertile valley. I have seen it intimated that the lands were so decidedly inferior and unproductive that the intention of the government in giving it over to the school to be managed by scientific men was to put the value of scientific principles in agriculture to the severest possible test. I believe, if such was the case, that there has been little reason to exult in the triumphs gained over such powerful natural obstacles as a poor soil and an ungenial climate, and I think it may be taken to be as great a mistake to select land for a model farm, or an agricultural college farm, that is much below the average of natural fertility, as it



would be to select one very much above it. In the first case even scientific management can hardly be charged with the responsibility of a failure to produce high crops, and in the latter, it would not get the credit of whatever it did produce. Neither would be a fair test of the skill and science applied to it.

The character of the soil led to the early adoption of a twenty years rotation, in which wheat came in but once, oats five times, rye and barley one year each, grass occupying six years, and one year being given over to an idle fallow.

The buildings are old and immense in extent, arranged in the form of parallelograms, with broad open courts or yards between. The whole has an air of majestic desolation. I do not think palaces especially well adapted for the purposes of agricultural schools. The endless stables were partially occupied by horses belonging to the Bavarian cavalry.

The course of instruction is more practical than theoretical, that is, of the time devoted to study and training, two-thirds is given to practical work and one-third to theoretical.

The theoretical instruction, which comes mostly in winter and on rainy days in summer, when it becomes impracticable to work out doors, embraces—

1. Religion. A brief survey of the history of religion and biblical history.

2. Elementary studies, arithmetic, orthography. In arithmetic, the fundamental rules and fractions, exercises in reducing common currencies, weights and measures, and measurements of space. It is especially mathematics applied to agriculture. As large a proportion as possible is mental.

About an hour a week is devoted to orthography, to teach correct writing and language, and to develop facility in writing. It includes examples of receipts, bills, notices, &c.

3. Agriculture. On climate, atmosphere, knowledge and estimation of kinds of soil and their cultivation or working. On machines and implements, their manufacture and repair, the parts of which they are composed and their use, the handling and management of sowing, threshing and cutting machines, to guard against accidents. On the formation of manure heaps and the manufacture of manure, the application of different sorts of manure. On the knowledge of seeds, and the different methods of sowing and planting. The treatment of plants during the period of growth. The reduction of different feeding substances to the hay value. Estimation of the necessary requirements of manure. On the various methods of harvesting, threshing, preservation and drying. On the valuation of fruits. On the arrangement and keeping of simple farm registers. Plan and model drawing from measurement.

TECHNICAL EMPLOYMENTS.—On milk and the products of milk. On the erection and management of brandy distilleries, and the suitable materials to use.

CULTURE OF MOWING LANDS.—Preliminary instruction. 1. Leveling by the application of the level and other instruments. 2. Measuring of level surfaces, lines, angles, and figures; triangles, quadrangles, right angles, the circle, practical exercises in these operations. 3. Laying out trenches and dams for water or irrigated meadows, calculation of bodies of water, and the requirements of water for irrigated meadows. 4. Tools for field culture

The practical management of meadows. Study of meadow or field plants. Requirements of seed and time of sowing. Seed raising. Manuring mowings with barn and compost manures, with liquid and artificial manures; the hay harvest and its yield. Preparation of brown hay; care and improvement of meadows other than irrigation.

DRAINAGE.—When and how to be applied. The work preparatory to draining.

CATTLE BREEDING.—Application of anatomy to horse, cattle, sheep, and swine breeding. The various breeds and their characteristics. Explanation of particular methods of improving the breeds of cattle, through the introduction of foreign males, and through in and in breeding, &c.

1. Explanation of characteristics according to the kind of use required, feeding for beef, milk and draught.

2. Choice of animals for breeding, according to age, use, special points.



3. Treatment of the breeding animal, feeding and care.
4. Parturition. Treatment immediately after.
5. Management of the calf. Methods of raising. Quantity and quality of milk for its nourishment.
6. Feeding, management and care of the young animal up to the period of use.
7. The same of the full-grown animal. Quantity and quality of food for milking, fattening, and working animals. Housing of sheep, product of wool, and the cleansing of it.
8. Adaptation to work.
9. Purchase and sale of animals, especially the horse.

The students are instructed in veterinary manipulations, which as far as possible are applied to practice. Bleeding at several points in different animals. Treatment of wounds, &c. Shoeing of horses and oxen.

The proper management of forests in all its branches, also forms a part of the instruction, as well as that of fruit trees.

Excursions are also made to neighboring estates for the purposes of observation, the results of which are written out by the pupils. Money is sometimes appropriated by the government to defray the expenses of long excursions.

Experiments are conducted in the making of implements, the application of manures, and the cultivation of plants.

There is a collection of models, a herbarium, a library, and tools and workshops for repairing the smaller agricultural implements, and the preparation of models. The students are held to a pretty strict line of conduct; neatness, order and industry are inculcated and required. An examination takes place at the close of the course, and prizes are awarded according to merit.

The number of cows kept is ninety; the number of yokes of oxen, thirty-six. They make cheese and butter. The age of the students varies from sixteen to twenty. The tuition, board, &c., amounts to about eighty florins, or about thirty-three dollars. Each student costs the government about one hundred and twenty-five florins, but the balance is made up from the public treasury.

The young men are certainly not liable to acquire luxurious habits here. I visited them, by invitation of Professor Anselm, teacher of agriculture, while they were at supper, and had various opportunities for conversation with several of them. Their fare appeared to be what, in our reformatory and correctional institutions, would be called "very hard," and yet they seemed to be quite contented and happy.

I should think the institution well calculated to send out a hardy, frugal, intelligent, industrious class of young men, who might testify with regard to their training as Socrates did with regard to Xantippe, "being firmly convinced that in case I should be able to endure her, I should be able to endure all others."

There is nothing imposing in the buildings or their arrangement. They are substantially built of stone, in low, long ranges surrounding a large yard or open space. There is a blacksmith's and a wheelwright's shop in a part of the range, and many agricultural implements are turned out here by the slow processes of hand labor, some of them excellent, but all rather more remarkable for strength than elegance.

#### INSTRUCTION IN FORESTRY AND HORTICULTURE.

1. In addition to the instruction given in the agricultural section of the real gymnasium and the trade schools, there are arranged courses of lectures in the university at Munich, and another special course of two years in the royal forestry school at Aschaffenberg.

2. The lectures on botany and vegetable physiology in the university, the practical work of the botanical garden, and the plantations of the public parks and grounds, afford rare opportunity for horticultural study as well as landscape gardening.

## SPECIAL SCHOOLS FOR WOMEN.

Besides the numerous schools of the usual grades for girls and young ladies in Munich, there are several institutions of a peculiar character to prepare them for profitable occupations. Under the lead of several noble women, among whom are Mrs. Maria Von Weber, Eugenia Dollman, daughter of the celebrated architect Klentze, Mrs. Maria Volk, daughter of Kolbach, Caroline Hay, and others, an Art School for Young Women has been instituted—one of the first of its kind in Germany. Beginning in a small hired apartment, they bought models, procured the services of an experienced teacher of drawing—a pupil of Leutze before he came to this country, and opened the school; and before the close of the first year numbered twenty-four eager pupils. The second year opened with a class in painting, under the instruction of an eminent artist—and during the following winter, lectures were delivered to the school on *Æsthetics* and the History of Art, by a Professor of the Royal Academy of Arts—the object of the school being to train its pupils to become themselves teachers of drawing and painting, and designers of patterns for various textile fabrics, household furniture and ornamentation.

There is also another institution for training girls between the ages of thirteen and sixteen for commercial business. It has been supported for several years at the expense of Mr. Adolph Remenschmied, a philanthropic merchant of Munich. The branches taught are such as are usually required in Schools of Commerce for Young Men, and are designed to fit young women to judge of the quality of goods, effect sales, keep accounts for others, and for independent business for themselves, if they should have the talent and opportunity.

Graduates of this school are already in responsible situations as book-keepers and managers of business for themselves and others.

The success of the school has led to the establishment of similar institutions in other commercial cities of Germany.



## SPECIAL INSTRUCTION IN DUCHY OF BRUNSWICK.

### INTRODUCTION.

The Duchy of Brunswick, on an area of 1,526 square miles, comprised in two portions widely separated, had in 1861, 282,400 inhabitants.

The governmental supervision of public schools belongs to a division in the department of the Interior, in which the consistory of the Lutheran church is largely represented. The system\* and statistics of public schools and education in 1867, were as follows:

1. *Elementary Schools*: 379 parish schools in rural districts, with 406 teachers and 33,700 pupils; 41 village and city public schools, with 255 teachers and 12,000 pupils.

2. *Secondary Schools*: 5 Classical Gymnasium, (including 1 real school and 1 progymnasium,) with 67 teachers, 871 pupils, besides 21 latin classes in other schools.

3. *Superior School*: Collegium Carolinum, with a classical, technical, and commercial department, with 25 professors and 180 pupils, including the technical division, which has an independent course.

4. *Special and Professional Schools*: The technical department of the Collegium Carolinum with eight special schools; 1 carpenters school; 1 agricultural school; 3 secondary and every-trade schools; 1 theological seminary; 2 normal schools for common school teachers; 5 young ladies' seminaries; 1 institute for deaf mutes; 1 school for the blind; 5 orphan asylums; 2 rescue and reform schools; 5 infant gardens and schools; 3 parish schools for Catholic children; 1 Jewish institution with an endowment of \$100,000.

### TECHNICAL COLLEGE AT BRUNSWICK.†

THE COLLEGIUM CAROLINUM, in the city of Brunswick, prepares young men by a scientific and technical education, for the special careers of—mechanicians, civil engineers, architects, metallurgists for mining and salt works, manufacturing or dispensing chemists, forest engineers, agriculturists, officers for railways and roads, and surveyors.

\*For an account of the system of Public Instruction in Duchy of Brunswick, see Special Report on National Education, Part I, *German States*.

†The details of the Technical College are taken from the report of the French Commission, and the Programmes of the Institution.

From the comprehensive curriculum, each pupil chooses the subjects required for his future destination. But when the pupil has entered his name for a particular line of studies, and he wishes to obtain from the College a certificate of proficiency, he is obliged to follow all the courses taught in that technical branch.

Besides these special studies there are college courses of literature, living languages, history, general and political geography, statistics, political economy, which the pupils are encouraged to follow as useful adjuncts to the scientific teaching.

The duration of the complete studies of the nine technical divisions is fixed as follows :

1. Construction of machines,	-	-	-	-	-	3	years.
2. Civil engineering, construction and architecture,	-	-	-	-	-	4	"
3. Metal works and salt mines,	-	-	-	-	-	3	"
4. Manufacturing chemistry,	-	-	-	-	-	3	"
5. Dispensing chemistry,	-	-	-	-	-	1	"
6. Forest economy,	-	-	-	-	-	2	"
7. Agricultural economy,	-	-	-	-	-	2	"
8. Service of railways and posts,	-	-	-	-	-	1	"
9. Government survey,	-	-	-	-	-	2	"

The teaching elementary mathematics, experimental physics, general chemistry, the rudiments of the natural sciences and of free-hand drawing, is common to all the divisions. Proof of sufficient preparatory instruction is required for admission to each division.

At the end of every year's studies, the Director and professors decide as to the passing of the pupils to the upper class of their division. Those whose proficiency is doubtful have to undergo, on their return after the vacation, a special examination, after which the decision is given. A pupil who has followed the complete courses of his division receives on leaving a certificate of proficiency.

Besides the pupils regularly matriculated for the technical divisions, free students are admitted to certain courses, as well as to the lessons in drawing, painting, and sculpture; young men are at all times admitted to the class-rooms and studies.

Numerous and well arranged collections and a good library are placed at the disposal of the professors and the use of pupils.

The following tables show the number of hours allotted weekly to each branch of instruction for the special divisions for a half-year.

The pupils who do not follow the plan of studies indicated for any special branch, do not receive the certificate relating thereto.

*First Technical Division.—Mechanicians, Constructors, &c.*

In order to shorten the length of the studies, the pupils begin to



attend the special courses before their instruction in the higher mathematics is completely terminated. The courses of construction of machines are to follow simultaneously and in connexion with those of mechanics, the study of machines, or projects, and exercises of construction.

								Hours per week
<i>First Year.—1ST TERM.</i>								
Arithmetic and algebra,	-	-	-	-	-	-	-	5
Geometry and trigonometry,	-	-	-	-	-	-	-	5
Knowledge of instruments,	-	-	-	-	-	-	-	2
Experimental physics,	-	-	-	-	-	-	-	5
Inorganic chemistry,	-	-	-	-	-	-	-	5
Free-hand drawing,	-	-	-	-	-	-	-	—
 <i>2D TERM.</i>								
Stereometry and spherical trigonometry,	-	-	-	-	-	-	-	5
Equations,	-	-	-	-	-	-	-	2
Analytical geometry,	-	-	-	-	-	-	-	5
Practical geometry*,	-	-	-	-	-	-	-	5
Experimental chemistry, second course,	-	-	-	-	-	-	-	5
Drawing of plans*,	-	-	-	-	-	-	-	—
Free-hand drawing,	-	-	-	-	-	-	-	—
 <i>Second Year.—3D TERM.</i>								
Differential calculus, 1st course,	-	-	-	-	-	-	-	5
Descriptive geometry, 1st course,	-	-	-	-	-	-	-	4
Mineralogy,	-	-	-	-	-	-	-	5
Technical chemistry, 1st course,	-	-	-	-	-	-	-	5
Drawing of machines,	-	-	-	-	-	-	-	—
 <i>4TH TERM.</i>								
Differential calculus, 2d course,	-	-	-	-	-	-	-	5
Descriptive geometry, 2d course,	-	-	-	-	-	-	-	4
Geology,	-	-	-	-	-	-	-	5
Mechanics, 1st course,	-	-	-	-	-	-	-	4
Elements of building construction,	-	-	-	-	-	-	-	4
Drawing of machines,	-	-	-	-	-	-	-	—

*Second Technical Division.—Construction of Buildings.*

The divisions for the construction of buildings, for civil engineering, and for architecture have nearly all the preparatory studies in common; they have also several points in common with the special studies. So, when the pupils have decided for one or other of the eight subdivisions, it is only in the exercises of drawing, projects and the applications relating thereto, that their teaching differs from that of the other two subdivisions.

								Hours per week.
<i>First Year.—1ST TERM.</i>								
Arithmetic and algebra,	-	-	-	-	-	-	-	5
Geometry and trigonometry,	-	-	-	-	-	-	-	5
Knowledge of instruments,	-	-	-	-	-	-	-	2

\*These courses are not compulsory; but the pupils are earnestly recommended to follow punctually the courses comprised in their studies, and not to neglect those which tend to the general culture of the mind.

	Hours per week.
Experimental physics, 1st course, - - - - -	5
Inorganic chemistry, - - - - -	5
Free-hand drawing, - - - - -	—

## 2D TERM.

Stereometry and spherical trigonometry, - - - - -	5
Theory of equations, - - - - -	2
Analytical geometry, - - - - -	5
Practical geometry, - - - - -	5
Experimental physics, - - - - -	5
Drawing of plans, - - - - -	—
Free-hand drawing, - - - - -	—

## Second Year.—3D TERM.

Differential calculus, 1st course, - - - - -	5
Descriptive geometry, 1st course, - - - - -	4
Land surveying*, - - - - -	2
Technical chemistry, - - - - -	5
Mineralogy, - - - - -	5
History of architecture, 1st course, - - - - -	2
Drawing of ornaments, - - - - -	—

## 4TH TERM.

Differential calculus, 2d course, - - - - -	5
Descriptive geometry, 2d course, - - - - -	4
Higher land surveying*, - - - - -	3
Geology, - - - - -	5
Mechanics, 1st course, - - - - -	4
Elements of building construction, 1st course, - - - - -	1
Drawing of ornaments, - - - - -	—
Architectural drawing, - - - - -	—

## Third Year.—5TH TERM.

Differential calculus, 3d course, - - - - -	2
Descriptive geometry, 3d course, - - - - -	4
Technical physics, 1st course, - - - - -	2
Mechanics, 2d course, - - - - -	5
Elements of building construction, 2d course, - - - - -	4
Architectural drawing and construction, - - - - -	—

## 6TH TERM.

Technical physics, 2d course, - - - - -	2
Mathematical physics, 2d course, - - - - -	2
Mechanics, 3d course, - - - - -	4
Elements of building construction, 3d course, - - - - -	4
History of architecture, 2d course, - - - - -	4
Building materials, - - - - -	2
Architectural drawing and construction, - - - - -	—

## Fourth Year.—7TH TERM.

Analytical mechanics, - - - - -	4
Mechanics of building, - - - - -	2
Roads and railways, - - - - -	4
Building of Bridges, - - - - -	4
Civil law, - - - - -	3
Drawing of buildings, - - - - -	—
Architectural projects, - - - - -	—
Landscape drawing, - - - - -	—



	8TH TERM.	Hours per week.
Hydraulic constructions, - - - - -	-	4
Study of machines, - - - - -	-	4
Law relating to the erection of buildings, - - - - -	-	2
Drawing of constructions, - - - - -	-	—
Architectural projects, - - - - -	-	—
Landscape drawing, - - - - -	-	—

*Third Technical Division—Salt Mines and Metallurgical Works.*

These two subdivisions require the same preparatory studies. For the salt-mines a sound knowledge of geology and fossils is required, and for metallurgical works great proficiency in chemistry and mineralogy.

	First Year.—1ST TERM.	Hours per week
Arithmetic and algebra, - - - - -	-	5
Geometry and trigonometry, - - - - -	-	5
Knowledge of instruments*, - - - - -	-	2
Experimental physics, 1st course, - - - - -	-	5
Inorganic chemistry, - - - - -	-	5
Free-hand drawing, - - - - -	-	—

	2D TERM.	
Stereometry and spherical trigonometry, - - - - -	-	5
Theory and equations, - - - - -	-	2
Analytical geometry, - - - - -	-	5
Practical geometry*, - - - - -	-	5
Experimental physics, 2d course, - - - - -	-	5
Drawing of plans*, - - - - -	-	—
Free-hand drawing, - - - - -	-	—

	Second Year.—3D TERM.	
Differential calculus, 1st course, - - - - -	-	5
Descriptive geometry, 1st course, - - - - -	-	4
Technical physics, 1st course, - - - - -	-	2
Chemical physics, - - - - -	-	2
Mineralogy, - - - - -	-	5
Drawing of machines, - - - - -	-	—
Manipulations in the laboratory, - - - - -	-	—

	4TH TERM.	
Differential calculus, 2d course, - - - - -	-	5
Descriptive geometry, 2d course, - - - - -	-	4
Technical physics, 2d course, - - - - -	-	2
Geology, - - - - -	-	5
Mechanics, 1st course, - - - - -	-	4
Elements of construction, - - - - -	-	4
Drawing of machines and constructions; manipulations, - - - - -	-	—

	Third Year.—5TH TERM.	
Mechanics, 2d course, - - - - -	-	5
Mineralogical exercises, - - - - -	-	2
Elements of construction, 2d course, - - - - -	-	4
Projects of metallurgical works, - - - - -	-	—
Manipulations in the laboratory, - - - - -	-	—

	6TH TERM.	
Mechanics, 3d course, - - - - -	-	4 or 5
Metallurgy, - - - - -	-	2 or 3

	Hours per week.
Geological exercises, - - - - -	2
Elements of construction, 3d course, - - - - -	4
Projects of metallurgical works, - - - - -	—
Manipulations in the laboratory, - - - - -	—

*Fourth Technical Division.—Technical Chemistry.*

Besides a profound acquaintance with chemistry, the pupils of this division must know something about the construction of machines and buildings. An acquaintance with descriptive geometry is consequently necessary for them.

In the third year they are almost exclusively occupied with manipulations in the laboratory.

	Hours per week.
<i>First Year.—1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Experimental physics, 1st course, - - - - -	5
Inorganic chemistry, - - - - -	5
Free-hand drawing, - - - - -	—
<i>2D TERM.</i>	
Stereometry and trigonometry; physics, - - - - -	5
Experimental physics, 2d course, - - - - -	5
Organic chemistry, - - - - -	5
Botany, - - - - -	5
Free-hand drawing, - - - - -	—
<i>Second Year.—3D TERM.</i>	
Descriptive geometry, 1st course, - - - - -	4
Chemical physics, - - - - -	2
Technical chemistry, 1st course, - - - - -	5
Technical physics, 1st course, - - - - -	2
Mineralogy, - - - - -	5
Drawing of machines and laboratory manipulations, - - - - -	—
<i>4TH TERM.</i>	
Descriptive geometry, 2d course, - - - - -	4
Technical chemistry, 2d course, - - - - -	5
Technical physics, 2d course, - - - - -	3
Geology, - - - - -	5
Drawing of machines and laboratory manipulations, - - - - -	—
<i>Third Year.—5TH TERM.</i>	
Elements of machinery, - - - - -	4
Statistics, - - - - -	3
Projects of manufactories and working in the laboratory, - - - - -	—
<i>6TH TERM.</i>	
Political economy, - - - - -	3
Projects of manufactories and working in the laboratory, - - - - -	—

*Fifth Technical Division.—Pharmaceutical Chemists.*

The pharmaceutical studies must have been preceded by a practical apprenticeship.



	Hours per week.
<i>First Year.—1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Experimental physics, 1st course, - - - - -	5
Inorganic chemistry, - - - - -	5
Manipulation in the laboratory, - - - - -	—
 <i>2D TERM.</i>	
Experimental physics, 2d course, - - - - -	5
Organic chemistry, - - - - -	5
Botany, - - - - -	5
Pharmacy, - - - - -	5
Chemical jurisprudence, - - - - -	2
Manipulation in the laboratory, - - - - -	—
 <i>Second Year.—3D TERM.</i>	
Mineralogy, - - - - -	5
Zoology, - - - - -	5
Pharmacognosy, - - - - -	4
Chemical physics, - - - - -	2
Manipulation in the laboratory, - - - - -	—

*Sixth Technical Division.—Forest Economy.*

The plan of studies here separates the special from the preparatory studies. The pupils in the forest service of the country are advised to follow the first year of this division immediately on leaving the primary or other elementary schools, and then to have a year's practical apprenticeship in the forests, before they come to follow the special course of the second year.

	Hours per week.
<i>First Year.—1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Experimental physics, 1st course, - - - - -	5
Inorganic chemistry, - - - - -	5
Zoology, - - - - -	5
Mineralogy, - - - - -	5
 <i>2D TERM.</i>	
Stereometry and spherical trigonometry, - - - - -	5
Practical geometry, - - - - -	5
Experimental physics, 2d course, - - - - -	5
Organic chemistry, - - - - -	5
Botany, - - - - -	5
Geology, - - - - -	5
 <i>Second Year.—3D TERM.</i>	
Mathematical exercises, - - - - -	2 to 4
Climatology and knowledge of soils, - - - - -	2
Physiology of forest plants, - - - - -	4
Forest botany and culture of forests, - - - - -	6
Valuations of forests, - - - - -	3
Forest history and statistics, - - - - -	2
Civil Law, - - - - -	3
 <i>4TH TERM.</i>	
Mathematical exercises, - - - - -	2 to 4
Organization of labor, - - - - -	4

	Hours per week
Protection of forests.—Forest insects, - - - - -	4
Forest economy and police, - - - - -	4
Utilization of forests, - - - - -	3
Elements of the chase, - - - - -	2
Forest laws, - - - - -	2

*Seventh Technical Division.—Rural Economy.*

The pupils are advised to separate their studies in the same manner as in the preceding division.

	Hours per week.
<i>First Year —1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Experimental physics, 1st course, - - - - -	5
Inorganic chemistry, - - - - -	5
Zoology, - - - - -	5
Mineralogy, - - - - -	5
<i>2D TERM.</i>	
Stereometry and spherical trigonometry, - - - - -	5
Practical geometry, - - - - -	5
Experimental physics, 2d course, - - - - -	5
Organic chemistry, - - - - -	—
Botany, - - - - -	—
Geology, - - - - -	—
Drawing of plans, - - - - -	—
<i>Second Year.—3D TERM.</i>	
Agricultural economy, - - - - -	—
Anatomy of domestic animals, - - - - -	—
Rearing of cattle, - - - - -	—
Rearing of horses, - - - - -	—
Technical chemistry, - - - - -	—
General knowledge of machines*, - - - - -	—
Agricultural book-keeping, - - - - -	—
<i>4TH TERM.</i>	
Theory of agriculture proper, - - - - -	—
Culture of plants, - - - - -	—
Diseases of domestic animals, - - - - -	—
Elements of surgery and medicine, - - - - -	—
Valuation of farm property, - - - - -	—
Elements of agricultural building construction, - - - - -	—
Manipulations in the laboratory, - - - - -	—
<i>Third Year.—5TH TERM.</i>	
Differential calculus, 3d course, - - - - -	2
Descriptive geometry, 3d course, - - - - -	4
Technical physics*, - - - - -	2
Mechanics, 2d course, - - - - -	5
Construction of machines, 1st course, - - - - -	2
Elements of building construction, 2d course, - - - - -	4
Construction of machines (exercises,) - - - - -	—
<i>6TH TERM.</i>	
Technical physics, 2d course, - - - - -	2
Mathematical physics, - - - - -	2
Mechanics, 3d course, - - - - -	4



	Hours per week.
Construction of machines, 2d course, - - - - -	2
Study of machines, 2d course, - - - - -	4
Elements of building construction, 3d course, - - - - -	4
Construction of machines (exercises,) - - - - -	—

*Fourth Year.—7TH TERM.*

Analytical mechanics*, - - - - -	4
Mechanics of building, - - - - -	2
Construction of machines, 3d course, - - - - -	2
Study of machines, - - - - -	4
Civil engineering*, - - - - -	4
Construction of machines (exercises), - - - - -	—

*Eighth Technical Division.—Railways and Roads.*

The knowledge necessary for admission into this division are elementary mathematics, geography, statistics, the history of modern languages and literature.

	Hours per week.
<i>First Year.—1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Experimental physics, - - - - -	5
Geography and statistics, - - - - -	6
French language, - - - - -	6
English language, - - - - -	6

*2D TERM.*

Stereometry and spherical trigonometry, - - - - -	5
Political economy, - - - - -	3
History, - - - - -	5
German literature, - - - - -	3
French language and literature, - - - - -	3
English language and literature, - - - - -	8

*Second Year.—3D TERM.*

Mathematical exercises*, - - - - -	2 to 4
Technical physics, - - - - -	2
History, - - - - -	2
German literature, - - - - -	2
French language and literature, - - - - -	2
English language and literature, - - - - -	2
Civil law, - - - - -	2

*Ninth Technical Division.—Officers of the Government Survey.*

The young men who intend to enter this service must follow a course of two years composed nearly as follows :

	Hours per week.
<i>First Year.—1ST TERM.</i>	
Arithmetic and algebra, - - - - -	5
Geometry and trigonometry, - - - - -	5
Mathematical exercises, - - - - -	4 to 6
Knowledge of instruments, - - - - -	2
Experimental physics, - - - - -	5
<i>2D TERM.</i>	
Stereometry and spherical trigonometry, - - - - -	5
Theory of equations, - - - - -	2

	Hours per week.
Analytical geometry, - - - - -	5
Practical geometry, - - - - -	5
Mathematical exercises, - - - - -	4
Experimental physic, - - - - -	5
Drawing of plans, - - - - -	—

*Second Year.—3D TERM.*

Differential calculus, 1st course, - - - - -	5
Descriptive geometry, 1st course, - - - - -	4
Spherical astronomy, - - - - -	3
Mathematical exercises, - - - - -	2 to 4
Technical physics, - - - - -	2
Drawing of plans, - - - - -	—

4TH TERM.

Differential calculus, 2d course, - - - - -	5
Descriptive geometry, - - - - -	4
Higher land surveying, - - - - -	3
Geology, - - - - -	5

*Management.*—The direction is entrusted to a committee of three members, the oldest of whom is chairman. This committee is under the immediate control of the Minister of State. The college or council of professors is consulted with regard to the general interest, or for any change of the existing arrangements. It comprises all the principal professors, and is convoked by the chairman, or at the instance of one of the members of the managing committee. The conference of the professors is composed of all the professors and tutors. It is convoked to discuss the business of the school.

*School Fees.*—The young men matriculated as regular pupils pay 18 thalers for the half-yearly term, and if they take part in the manipulations an additional sum of 6 thalers. They also give the laboratory attendant 20 gros.

The young men who do not matriculate for the six months' term pay three thalers for a course of three hours a week, six thalers for one of five hours; the maximum paid is 18 thalers, whatever number of courses may be followed. For the laboratory, these pupils pay 10 thalers, and to the attendant 20 gros.

For daily participation in the lessons in arts, from eight in the morning till two in the afternoon, the fee is three thalers per quarter, and half that sum for three days a week.

The matriculation fee is two thalers, with 20 gros. to the apparitor and 10 gros. for the admission card.

*Discipline.*—Though all the pupils live outside the college, discipline is maintained in-doors and in the classes by the professors, each for his own course, and by the managing committee for general order and conduct out of college.

The Polytechnic Institution of Brunswick has no less than twenty-five professors for the different branches of instruction there given.



## BUILDERS' SCHOOL AT HOLZMINDEN.

In the small town of Holzminden, there is an establishment for special instruction, which, by a remarkable exception to the general rule in Germany, receives boarders. It is devoted to the class of artisans designated in France under the general term of the building trade; masons, stone-cutters, carpenters, joiners, smiths, slaters, glaziers, painters, cabinet makers, &c.

The instruction is chiefly given during the winter half-year, when work is generally suspended; but it is continued during the fine season also for those pupils who are disposed to attend. To be admitted, a young man must have already entered one of the trades connected with building, and must supply the necessary information as to his age, his parents, his residence, the master for whom he has worked, and as to his moral character; he must also submit to a medical examination with regard to his health. During their stay at the school, the pupils wear a uniform, which facilitates discipline. On entering they must bring linen, a few other articles, and a case of mathematical instruments.

The establishment supplies during the usual term of residence, which is twenty weeks for the winter half-year:

Lodging and board for the sum of	-	-	-	-	-	-	27 thalers.
Teaching, firing, lighting, necessaries for writing and drawing, the uniform, medical attendance and washing, for	-	-	-	-	-	-	45 thalers.
Total	-	-	-	-	-	-	<u>72 thalers.</u>

Thus, during this period of one hundred and forty days, a young man can be boarded, lodged, taught, and supplied with every necessary for less than two francs per day.

The pupils are divided according to their proficiency, into three classes. In the two lower classes, the pupils are improved in ordinary and commercial arithmetic, writing, and composition. At the same time in all the classes they are taught free hand drawing, details of construction, of ornament, of line-drawings relative to their different trades, the objects and models being chosen according to the capacities of the pupils.

The discipline is nearly the same as in a college. They rise at six in the morning, wash themselves and perform other necessary duties till half-past eight, and the studies continue till half-past nine in the evening, except the intervals for meals and recreation. They go to

bed at ten. The school can accommodate five hundred and fifty pupils.

At the close of each complete period of instruction, the pupils who are found deserving, and have attended long enough, receive a certificate stating their degree of proficiency in the studies bearing on their profession. The pupils who have not completed their studies receive a certificate of their conduct and application during the time passed at the school. This certificate must be countersigned by their parents or masters when they return for the next half year.

The general curriculum of the school comprises calligraphy, orthography, composition, ordinary and commercial arithmetic, the elements of algebra, book-keeping, elementary geometry, descriptive geometry, projections, stereometry, elementary and technical physics, the details of the construction of machines and buildings; joining of stone, wood, and iron; technical chemistry, the knowledge of building materials, drawing up of estimates, laws affecting buildings, free-hand drawing, architectural drawing, studies of forms and orders, drawing of machines, drawing up of projects, modeling. The pupils are expected during the summer half-year, to visit works in course of execution, and write reports of their excursions.



## SPECIAL INSTRUCTION IN THE FREE CITIES OF GERMANY.

### I. HAMBURG.

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The small republic of Hamburg had, in 1869, a population of 315,000, of which there are in the city and its suburbs 225,000, and in the outlying districts, 90,000.

Besides being a great commercial emporium, and the centre of a very extensive business in marine insurance, it has important branches of home industry ; shipbuilding on a large scale, with sail-cloth, ropes, sugar refining, distilling and dyeing, manufacture of cigars, &c.

The total expenditure for educational purposes amounted, in 1869, to about 800,000 thalers, of which 109,302 were borne by the State, to which last item is to be added 12,640 thalers for special schools, and about 5,500 for the city library, botanic garden, and similar establishments.

The educational institutions of Hamburg number 437, with 2,521 instructors and 39,098 pupils, and are, in the official report, divided into the following classes :

(1.) *Public Schools.* City and Parish schools 64, with 183 teachers and 8,135 pupils. Schools for the poor (*Armen-Oschulen*) 20, with 142 teachers, and 5,079 pupils. Foundation schools (*Stiftungsschulen*) 21, with 131 teachers and 2,376 pupils. Church Schools (*Kirchenschulen*) 27, with 130 teachers and 4,235 pupils.

(2.) *Private Schools.* Elementary schools 49, with 127 teachers and 1,922 pupils. Middle schools 108, with 562 teachers and 8,212 pupils. Higher schools 89, with 1,046 teachers and 7,686 pupils.

There are, besides, 29 *Kindergärten*, of which 7 are in connection with other schools, with 68 teachers and 973 children attending. Also 30 private courses, with 132 instructors and 480 pupils.

*Elementary Schools.*—Nearly all the schools included in the above official statement as Public Schools, may be classed as elementary.

*Secondary Schools.*—The gymnasium has eight classes, with 11 professors, and 7 assistants. The Model School has a Real department, and Female High School.

*Superior Education.*—The Gymnasial Academy, founded in 1632, is a connecting link between the classical schools and the University.

There are four professors; one of classical philology, who is also city-librarian; one of chemistry, one of biblical philology and philosophy, and one of natural history, who is also director of the botanic garden. There is also a teacher of mathematics.

*Professional and Special Schools.* There are four special schools for teachers,—one for gymnasiums and real schools, two for elementary schools, one for males and one for females, and one for the *Kindergärten*;—one evening trade school for males with 29 teachers and 809 pupils; one trade school for females with 77 pupils; one trade school in the suburb St. Paul with 4 teachers and 36 pupils; a winter day school for the building trades, with 106 pupils; the evening school of the educational union, with about 200 pupils; one polytechnic preparatory school with 16 teachers and 38 pupils; a navigation school with 3 teachers and 85 pupils; a private seamen's school with 5 teachers and 43 pupils.

#### PUBLIC TRADE SCHOOL AND SCHOOL FOR THE BUILDING TRADES.

The public trade, and the building school (*Gewerbe Schule, und Schule für Bauhandwerker*), at Hamburg, have for their object to give to all men engaged in any trade, but especially apprentices and workmen connected with the building trades, such instruction as shall be of use to them in their occupations. They are held in the same rooms and under the same director.

The hours of instruction in the trade school are two to sixteen weekly, in the evening, and the branches are German with business writings in German, book-keeping, arithmetic, algebra, geometry, physics, free hand drawing, and drawing with the compass, drawings as applied to the trades of building, ship-building, metal working, and those trades in which some knowledge of art is required, modeling and elementary instruction in drawing for boys.

The hours for instruction in the building trade schools are fifty-four, weekly, during the winter, and three winters are required to finish the course. The number of pupils in the trade school is (1868) 809, in the building school 106.

The number of scholars (1868) is, in the trade school about 500 in winter, and 600 in summer; in the architectural school, held only in the winter, 106.

The director is paid about 1,500 thalers per annum; the teachers (28 in all) thirty thalers per week during the course. Tuition in trade school, 2 to 4 thalers the course; in the building schools, 30 thalers the half year.

We add a brief notice of the common method of teaching drawing:

Free drawing without instruments begins with drawing from wooden models, according to Heimerdinger's method, in which simple objects, such as tools used by joiners, engineers, &c., are included; attention being paid to the vocation of the pupil in the choice of the models. Ornamental drawing from plaster casts, in outline, and in respect to shading, then follows. Those pupils who devote themselves to building or ornamental trades, study the figure from casts and anatomy. The metal workers draw freely, without instruments, portions of machinery, &c. The mode of execution (which is with lead pencil, pen, brush, and rubber,) is always the most suitable to the branch of technical art to which the pupil intends to devote himself. In close connection with this style of drawing, are the exercises in ornamental design. Plants, flowers, and leaves are drawn from life, and



these drawings are used in designing. By these exercises the pupils become very soon independent of all help. Geometrical drawings are executed from large copies. The teachers explain the perfect principles of construction, and pay special attention to exactness in execution. When the pupil has acquired confidence in the use of his instruments, and has mastered the essential principles, the measuring and drawing of some simple and more complicated bodies follows. This class is attended by metal-workers, joiners, builders, and carpenters, carriage-builders, ship-builders, &c. The instruction is imparted by measuring and drawing real objects, such as parts of machinery, tools, furniture, doors, windows, carriages, &c., according to fixed rules and specified plans.

Instruction in free-hand drawing can only be of use to the pupils when they use real objects, and not drawings. By the method pursued here, the hand needs no particular preparation, because the nearest model offers an example by which the hand and eye are both alike exercised. No particular introduction to the rules of perspective is needed, the scholar learns to see correctly, and his attention is directed to the principles of perspective by the teacher.

From the specimens of free-hand drawing which were exhibited at Paris this year, it would appear that no method can compare with that here referred to, for producing a satisfactory result in a short time. The results of several other industrial schools are in this respect far behind those of the Hamburg school. Drawing from specimens should be entirely avoided in industrial schools, in free-hand as well as in geometrical and technical drawing. In the instruction of teachers, this method has been followed for a number of years in Mr. Jessen's Polytechnic Institute, and also for the last two years in the Hamburg Trade School, with most satisfactory results. The pupils of both show great application and zeal, and make good progress. There are no workshops connected with the trade school.

#### PLAN OF A TRADE SCHOOL.

IN 1862-63, the Hamburg Patriotic Society, established for the promotion of art and industry, appointed a committee to visit different countries in which attention had been paid to institutions of science and art, especially in reference to the advancement of national industries, and report a plan for the re-organization of existing institutions of this kind in Hamburg, or the establishment of new. The committee, after visiting the polytechnic and trade schools of Bremen, Frankfort, Brunswick, Stuttgart, Carlsruhe, Munich, and other cities, as the result of their inquiries, recommended the following

##### *Plan for a Trade School for Hamburg.*

The aim of the Trade School shall be to give those employed in trades an opportunity of acquiring such knowledge and attainments as they stand in need of for an intelligent prosecution of their callings.

In order to carry out this object in a comprehensive manner, a complete trade school should be divided into three quite different departments :

1. *A Sunday and evening school* for such pupils as can take advantage of the instruction during the few hours of the week which they have at liberty from their other school time or from being otherwise engaged.

2. *A winter school of architecture* for those engaged in the building trades, and who will be able to give their time exclusively during the winter months to the attainment of theoretical knowledge and skill.

3. *A day trade school* for young persons who have already left the primary school, and are in a position to be able to devote the whole of their time for a year to their industrial education before they are apprenticed to a trade.

Although the education of artisans is the end which these departments have in view, and this can be attained, for the most part, by the same subjects of study, yet there must be a difference between them according to the requirements of the pupils attending the different establishments; and especially as to the time to

be given to separate subjects, as well as regards the subjects taught, as also as regards the extent to which they are taught.

Whilst in all three departments the instruction will be, as far as possible, the same, especial regard will be paid, in all the subjects taught, to the profession which the pupils may have already embraced, or for which they may be destined.

#### I. SUNDAY AND EVENING SCHOOL.

The subjects taught comprise :

1. Commercial composition and book-keeping, (orthography, the formation of words and sentences, the composition of letters, invoices, agreements, &c.)
2. Mathematics. *a.* Arithmetic and algebra, (fractions, algebraic notation, equations, 1st and 2d degrec.) *b.* Geometry, (plane and solid geometry.)
3. Physics, (elements of physics in general, the science of heat, elements of acoustics, optics, electricity, and magnetism.)
4. Mechanics, (elementary mechanics, gravity, motion, friction, pressure of water, water power, pressure of air, steam engines.)
5. Chemistry, (elements of inorganic chemistry, special important branches of organic chemistry.)
6. Technology and knowledge of implements.
7. Political economy.
8. Free-hand drawing, (from simple objects, from ornamental objects, figures, parts of machinery, &c.)
9. Geometric drawing, (drawing by compass,) and geometric figures, (geometrical constructions, measuring and drawing by rule, perspective.)
10. Special drawing with practice in design and construction, (in 5 classes, for building, for manufactures, for workers in metal, for workers in wood, for ship-building.)
11. Modeling in clay, wood, and wax.

The course of study is for three years, and the regular entrance of the pupils takes place at Easter. Young persons are received as pupils who have completed their fourteenth year and possess a competent knowledge of the usual branches of school education. To each pupil is prescribed by the superior which classes he is to attend; of course, as far as possible, in this matter the wishes of the pupil or of his relations are taken into consideration.

The school is intended for 600 pupils, and the committee think they may with certainty reckon upon this number, when it is considered that towns such as Nuremberg and Chemnitz have trade schools which are attended by 1,800 pupils.

The average number for each class is to be reckoned at 35 pupils.

The school is under the superintendence of a director, subordinate to him are masters for the various subjects.

The number of lessons weekly, amounts, for each pupil, to from 6 to 8.

#### *Weekly Plan of the Lessons.*

LESSONS.	COURSE OF THE YEAR.					
	I.		II.		III.	
	Classes.	Hours.	Classes.	Hours.	Classes.	Hours.
1. Commercial knowledge, &c., -	4	of 2	.....	.....	.....	.....
2. Mathematics, - - - -	4	of 2	4	of 2	1	of 1
3. Physics, - - - - -	.....	.....	2	of 2	.....	.....
4. Mechanics, - - - - -	.....	.....	.....	.....	4	of 2
5. Chemistry, - - - - -	.....	.....	.....	.....	2	of 2
6. Technology, - - - - -	.....	.....	.....	.....	1	of 2
7. Political economy, - - - -	.....	.....	.....	.....	1	of 1
8. Free-hand drawing, - - - -	4	of 4	2	of 4	.....	.....
9. Geometric drawing, &c., - -	2	of 4	4	of 4	.....	.....
10. Special drawing, - - - -	.....	.....	.....	.....	6	of 4
11. Modeling, - - - - -	.....	.....	.....	.....	2	of 4
	40 hours.		36 hours.		48 hours.	



Thus, altogether 124 hours of study weekly.

To the Sunday and evening school there is also a preparatory class annexed, for those who are not yet sufficiently acquainted with the ordinary branches of school knowledge. This preparatory class comprises the following subjects :

1. German language.
2. Arithmetic.
3. Geometry.
4. Free-hand drawing.

And the arrangement of the classes is as follows :

1. German language,	-	-	-	-	2	classes	of	2	hours.
2. Arithmetic,	-	-	-	-	2	"		2	"
3. Geometry,	-	-	-	-	2	"		2	"
4. Free-hand drawing,	-	.	-	-	2	"		2	"
Total,					- 16 hours weekly.				

The yearly expenditure for the Sunday and evening school, and for the preparatory class, is estimated altogether at 25,000 marks current, according to the following table :

	Mks. ct.
For the director, including a salary for 10 hours lessons a week,	- 4,000
Salary for 130 hours lessons a week at 100 mks. ct. each per year,	13,000
Rent of premises,	- 5,000
School apparatus,	- 500
Servants,	- 200
Warming, lighting, and cleansing,	- 2,000
Total,	- 25,000

To meet this we may reckon upon a yearly income of 18,000 marks current, viz: 600 pupils, at 30 marks school fees per year, so that a yearly grant is requisite of 7,000 marks current.

## II. WINTER SCHOOL OF ARCHITECTURE.

The subjects taught are :

1. Commercial composition and book-keeping.
2. Mathematics.
  - a. Arithmetic and algebra.
  - b. Geometry.
3. Physics.
4. Mechanics.
5. Free-hand drawing.
6. Geometric drawing.
7. Applied geometry.
8. Architectural drawing, and plans of buildings.
9. The art of building, the knowledge of construction, and estimating the cost of buildings.
10. Constructive modeling.

The course of study is for three years, and the instruction is given during the five winter months, (November to March,) in 48 weekly lessons; besides these, written exercises are prepared under the superintendence of a teacher in 12 weekly lessons.

Such persons are accepted as pupils as are engaged in construction, and who are acquainted with the ordinary school knowledge; those who are deficient in the latter are referred to the Sunday and evening school.

The school is intended for 100 pupils; it is placed under the superintendence of the director of the trade school. There are masters who teach under and in addition to him.

*Plan of the Lessons.*

LESSONS.	COURSE OF THE YEAR.		
	I.	II.	III.
	Hours.	Hours.	Hours.
1. Commercial knowledge, &c, -	2	2	2
2. Mathematics:			
Arithmetic and algebra, -	6	3	} 1
Geometry, - - - - -	6	3	
3. Physics, - - - - -	2	1	..
4. Mechanics, - - - - -	..	..	4
5. Free-hand drawing, - - -	8	8	6
6. Geometric drawing, - - -	8	..	..
7. Applied geometry, - - -	..	8	..
8. Drawing of buildings, - -	16	16	20
9. Art of building, &c., - -	..	7	7
10. Constructive modeling, - -	..	..	8
	48	48	48

Besides this, 13 hours are set apart weekly for the preparation of written exercises, under the superintendence of a teacher for all the classes in common, at the same time, participation in this instruction is not obligatory for those who undertake this work at home. The yearly expenditure is estimated at 8,300 marks current, viz:

	Mks. ct.
For superintendence, including salary for 6 lessons per week, -	1,000
Salary for 150 lessons per week, for 5 months, at 40 marks per lesson, 6,000	6,000
School apparatus, - - - - -	300
Servants, - - - - -	150
Premises, (those of the Sunday and evening schools,) - - -	....
Warming, lighting, and cleansing, - - - - -	850
Total, - - - - -	8,300

Against this we may reckon upon a yearly receipt of 5,000 marks current, viz: 100 pupils at 50 marks, so that an annual addition of 3,300 marks current will be necessary.

## III. THE DAY TRADE SCHOOL.

The subjects taught comprise:

1. German and composition.
2. Mathematics.
  - a. Arithmetic and algebra. (Fractions, algebraic notation, equations of the first and second degree, powers and roots, logarithms.)
  - b. Geometry. (Plane and solid geometry.)
  - c. Trigonometry. (Plane trigonometry.)
3. Physics. (Physics in general, science of heat, principles of the remaining branches.)
4. Chemistry. (Inorganic, and some sections of organic chemistry.)
5. Free-hand drawing.
6. Geometric drawing.

The course of lessons is for one year, and the regular entrance of pupils takes place at Easter.

Such young persons are accepted as pupils as have completed their fourteenth year, and who show proof of the requisite capacity to comprehend the above-named subjects.

The school is primarily intended for a class of 35 pupils; it is placed under the director of the trade school. A master instructs in the head branches,



assisted by teachers. The annual expenditure is estimated at 5,200 marks current, viz :

Salary of the head-master, who gives 24 lessons per week, 3,000 marks ; salary for 18 lessons per week, 1,800 ; premises (those of the Sunday school and evening school) ; school apparatus, 200 ; servant, 50 ; warming, 150 ; total, 5,200.

Against this we may reckon upon an annual income of 3,500 marks, viz : 35 pupils at 100 marks, which will require an annual addition of 1,700 marks current.

A trade educational establishment, (comprising : *a.* A Sunday and evening school ; *b.* A winter school of construction ; *c.* A day trade school ;) would, therefore, require an annual expenditure of 38,500 marks current ; deducting from this the estimated annual receipt of 26,500, there will remain to be asked an annual grant of 12,000 marks current from the municipality.

#### IV. INDUSTRIAL MUSEUM.

As a second means towards the support and promotion of the industry of the city, the committee recommend the establishment of an *industrial museum with exhibitions of products*, after the model of those in other states, especially in Wurtemberg, England, and France.

Although for years past the importance of education through the eyes has been recognized as essential for the completion of instruction proper in industry, still a long time elapsed before the example of France, who in 1783, founded the *Conservatoire des Arts et Metiers*, has been followed in other countries.

It was only in 1850 that an exhibition was opened at Stuttgart, under the direction of the Royal Academy, for industry and commerce, and it was first the great universal exhibition in London, in the year 1851, which induced the English to found their richly endowed Kensington Museum. Since that time, in many places, efforts have been made to supply this deficiency, and at this time we hear of even small towns which are occupied in the establishment of industrial museums. The special experience of Wurtemberg is most favorable as to the utility of such an establishment.

In addition, the foundation in Hamburg of an industrial museum is to be recommended on commercial considerations. Hamburg despatches daily to the interior, raw materials ; travelers from Hamburg range through the interior in order to find out objects of export. Might not in many cases the manufacture of these materials be carried on here ? In the second place, might not many Hamburg manufactures, which have already obtained a good reputation abroad, attain still greater success if the manufacturers, profiting by the beautiful forms brought under their eyes in a museum, were to employ these in their fabrics.

The aim of such an institution as the committee proposes, is to promote existing trades, to call forth new ones, and to increase the sale of manufactured goods. This aim is to be reached by the exhibition of raw materials, of the process of manufacture of improved implements, and of superior products of industry with special regard to the formation of taste.

The arrangement of an industrial museum will be as follows :

1. *A Technical Section.*—This contains raw materials, manufactures in process, implements, models, &c.

The collection of raw materials, and of manufactures in the different stages of their preparation should have in view an exact knowledge of their origin and price as well as of their uses, and at the same time should point out new uses. The collection of implements, utensils, and machinery should indicate means to the artisan of working better and at less cost.

2. *A Section for Art Manufactures.*—This comprises casts, engravings, drawings, photographs, &c., which ought to serve especially in the formation and improvement of taste in industrial drawing and design.

3. *The Exhibition of Products.*—This section contains especially good or useful new products of industry. The artisan should here be made acquainted, from seeing the fabric itself, with new combinations, beautiful forms, and new employment of materials, &c., in order that he may perceive clearly the possibility of a profitable new or improved manufacture. The commercial interest will also find here new fabrics, and be made acquainted with their origin. Every object should have attached to it the price, and the name and residence of the manufacturer.



The whole establishment is under the superintendence of a director, who should pay close attention to home and foreign industry, in order to develop the former from the experience of the latter. To this end he must place himself in correspondence with foreign exhibitions and industrial societies, &c., as also with the consuls for Hamburg, and with the home manufacturers.

Entrance to the museum should, as far as possible, be facilitated, and therefore the committee think it desirable on four days in the week to give admittance to all gratis, and on the other days to charge a moderate price of admission, in order in this way to gain a contribution towards the yearly cost.

The use of the museum must always under regulations be open to the trades schools, as they have a free claim to the use of the drawings and models therein contained, as means of instruction.

The committee think it necessary to give a right to the manufacturers of the city, not only to study the fabrics in the different sections in the locality of the exhibition, but if they desire it, to take these home with them for closer study.

#### NAVIGATION SCHOOLS.

1. The *Navigation School*, opened in 1826, by the Chamber of Commerce, contains two classes: one for lads who are pursuing the usual primary studies; and the other for seamen, who are qualifying themselves by a study of arithmetic, trigonometry, surveying, navigation, nautical astronomy, drawing, with special reference to charts; code of signals, theory of winds, tides, and currents, mercantile laws and usages, practical use of instruments used at sea, book-keeping, and correspondence. Steam and mechanics have been recently added.

No one can be employed as a master or under officer in a steam or sailing vessel belonging to Hamburg, without a certificate of proficiency in the studies of this school, which is managed by a committee of the Chamber of Commerce.

2. The *Seamen's School*, a private enterprise, receives as boarders 43 lads, under 15 years of age, for a two years' course in navigation. It employs three teachers, and charges 210 thalers a year for board and instruction.

#### MUSIC IN PUBLIC SCHOOLS.

Music is a regular subject of instruction in the public schools of Hamburg, but the method is left with each school and teacher. Mr. Eichberg, in his communication to the Boston School Committee on musical instruction in the principal cities of Germany, says:

Music is not taught uniformly in the Hamburg public schools, but the several teachers instruct independently of system. Two music lessons of one hour each are given to the pupils, either by their regular, or, in the higher schools, by an appointed special teacher. In the Latin school, four part songs, motets and chorals, are sung, the lower classes singing soprano and alto, while the higher classes take the tenor and basso parts. Pupils are not allowed to sing during the mutation of the voice, but have to be present at the music lessons. Great care is taken to avoid choruses requiring great extent of vocal compass. I found here Mr. Benedict Widmann's different publications well spoken of. They are named "Little Singing School, for the Three Divisions of Boys' and Girls' Schools," and "Prefatory Instruction in Singing." These two little works, (sixty-four and eighty-two pages respectively, in 12mo,) contain many novel ideas on class teaching. The author strongly advocates musical instruction in the primary schools, and maintains that the imitative faculties of the child render the teaching of singing far easier at an early age than it would be when the vocal organs have passed the period of their elastic softness.



## II. SPECIAL INSTRUCTION IN FRANKFORT.

## INTRODUCTION.

THE Free City of Frankfort, (now a portion of the new province of Nassau, in the kingdom of Prussia,) to which our school statistics refer, on a territory of 43 square miles, had in 1861 a population of 87,518, of which 70,000 belonged to the city proper. Besides its vast banking interests, there are large mechanical industries, in which beauty of form and nicety of execution are required, and which have been secured by the appropriate training of artists and artisans.

The public educational establishments are administered by five coordinate authorities, in which the city and the four religious denominations are represented, each by one commissioner. The expenditures for teachers (salaries and pensions), buildings, apparatus, and equipment generally by the city, are very liberal, but would be more effective by a simpler administration. The schools, except the gymnasium and the special schools, are mainly denominational in their management, and may be classified as follows:

I. *Elementary Schools*.—Eight country schools of a higher character, with 2,820 pupils; 4 Protestant burgher schools, with 2,230 pupils; 4 Catholic schools, with 950 pupils; 2 Jewish burgher schools, with 940 pupils. Total elementary pupils, 6,940.

II. *Secondary and Superior Schools*.—One gymnasium, with 20 teachers, a ten years' course, and an average of 160 pupils; 4 real-schools, with a Latin class in each, and about 900 pupils in all; 3 higher burgher schools, (Catholic, Protestant, and Jewish,) with a total of 1,350 pupils, male and female; and 3 female high schools, with 840 pupils, besides a large number (forty-four in 1863,) of private institutions with elementary and secondary classes.

III. *Special Schools and Institutions*.—One normal school, with 30 pupils; 1 gallery of architecture, painting, and sculpture, with a school of fine arts; 1 high school of arts and trades, with a preparatory school, and a total of 260 pupils; 1 school of commerce, with a preparatory school, and public lectures; 1 institute for deaf mutes, with 20 pupils; 1 orphan home, with 46 inmates; 2 infant asylums, with 60 inmates; 1 school of gymnastics; 1 house of refuge, with 24 inmates; the Senkenberg museum of natural history; public library of 70,000 volumes, &c. In addition, we may mention the Sunday and evening industrial school of the Society of Public Welfare, which receives subventions from the government; a private academy of commerce; a permanent museum for the exhibition of machinery; a school for medical gymnastics.

## SCHOOL OF COMMERCE, AND ACADEMY OF COMMERCE AND INDUSTRY.

The School of Commerce at Frankfort includes: (1.) An improvement school for clerks; (2.) A regular commercial school; (3.) An academy of commerce and industry. The school, like that at Leipsic, belongs to the chamber of commerce, and its direction is confided to a committee chosen by it, which committee renders a monthly report.

(1.) The *Improvement School* is open to pupils after they leave the primary schools. They must undergo an examination before being admitted. If they fail in this, they enter into a supplementary school annexed to the establishment, where they remain until they receive the necessary preparation, or fail in a second examination, in which last case they are advised not to pursue their studies.

The course lasts two years. The term begins after Easter and continues until Michaelmas; there are two lessons daily, one in the morning, and one in the afternoon, the hours varying according to the season and the press of business, being fixed by the chamber of commerce.

The studies pursued are German, French, English, commercial correspondence, the arithmetic, geography, and history of commerce, book-keeping, and calligraphy. The school is well attended, and the teaching is successful.

(2.) The *Commercial Division* is open to all who have finished the burgher school, or all but one of the classes of a gymnasium, or can pass an examination showing an equivalent grade of cultivation. By these means, pupils with a fair degree of secondary, general, and classical instruction are secured.

The course includes two classes of one *semester* each, and the branches taught are as follows, the hours being three hours in the morning and three in the afternoon: German, French, English, the arithmetic, correspondence, geography, and history of commerce, book-keeping, physics, chemistry, articles of commerce, calligraphy, and political economy applied to German commerce.

The following branches are optional, given at extra hours, and for a varying fee, according to special agreement: Italian, Spanish, and stenography.

(3.) The *Academy for Commerce*, open to all who desire to attend, on payment of a fee, is a course of lectures or conferences, which may be considered an additional *semester* to the last. The plan was borrowed from Faraday's lectures in the Royal Institution in London. Its aim is to give a high commercial education to the burgher class. It is administered by a committee of eight, chosen by ballot.

The course commences after Easter; the lectures occupy two or three hours in the morning and two or three in the afternoon. There are courses upon the languages, ethics, commerce, and science. The course upon the languages explains the principles of comparative grammar, illustrating with English, French, and German. It also includes remarks upon the literary styles of these tongues, and extracts from the best authors are repeated. That upon ethics embraces remarks upon the principal systems of philosophy, ancient and modern, the progress of material and moral civilization, and the influence of literature, and the growth of the arts upon social manners throughout the world. The course upon commerce embraces commercial law and convention, political economy, particularly in regard to the commerce of Germany, commercial geography and history, and the universal history of the industrial arts. That on science treats of the present condition of science, of the most recent discoveries in physics, and of chemistry applied to the knowledge of merchandise. There is also an afternoon course of Italian and Spanish, the fee, which varies according to the number of courses, being from ten to thirty francs the *semester*.



## TRADES' SCHOOLS.

The Frankfort Trades' Schools were founded by a society, formed in 1816, and called the "Society for the Promotion of useful Arts and Allied Sciences."

They include: (1.) A Sunday school for artisans; (2.) An evening school; (3.) A higher trades' school. The first aims at the completion of elementary education for such young persons as have already left the popular school. The second offers exclusive instruction in industrial technical drawing.

The *Higher Trades' School* imparts general and special instruction to those about to enter a trade, and prepares those about to devote themselves to some branch of technical industry for the special classes of higher institutions and the polytechnic school. Each class is complete in itself, every pupil leaving when fitted for his future business. For instance, those intended for the building trade leave after the second class; those who wish to devote themselves to architecture or engineering go on through the first.

The branches taught are mathematics, (including algebra, geometry, trigonometry, analytical and practical geometry, analysis,) natural philosophy, physics, chemistry, mechanics and machinery, descriptive geometry, architectural and machine drawing, topographical and free-hand drawing, German, French, history, literature, geography, and calligraphy.

Free-hand drawing is begun from copies, and goes on, as soon as possible, to drawing from casts. Particular attention is paid to ornamental drawing. Only the best pupils are allowed to undertake shading, and then only with the stump. Linear drawing begins with the construction of geometrical figures by which the pupil is practiced in the use of the rule, the compass, and the drawing pen, after which comes drawing from simple implements, then from wooden models, and finally the pupil is exercised in construction.

The fees for the evening school are six florins annually. There are none for the Sunday school, but a moderate entrance money is charged. In the higher trades' schools the fees vary from 30 to 50 florins, according to the class, of which there are four.

These fees, together with the contributions of the society, pay the expenses of the trades' schools. The cost of the Sunday and the evening schools is defrayed by the monthly fees, by contributions from the treasury of the society, and by the interest from a special school fund which is in the trusteeship of the society, and is increased by donations, by entrance fees to the Sunday school, and the interest of that portion of the fund which is less than 1,000 florins complete.

The administration of these schools is in the hands of a board of directors, consisting of nine members chosen by the society, of which three go out annually. They choose among themselves a director who presides, a vice-director, a secretary, a treasurer, a manager, and an assistant librarian. The immediate direction of the school, the maintenance of the fixed plan of studies, the care for the health and conduct of the pupils, and the conduct of the masters, and the execution of the orders of the board, is in the hands of the head-master, who has a seat in the board. The director conducts all business matters, and represents the school at the meetings of the society. The board has for its duties, to arrange the plan of studies, and to name the books, to provide apparatus, to appoint and dismiss teachers, to arrange prize competitions and holidays, and to manage the funds. They must consult the teachers in forming the plan of studies, and must attend the recitations from time to time.

## IV. LUBECK.

The free city and State of Lubeck, the nominal capital of the Hanse towns, on several isolated portions of territory, had a total population of 44,357, of which 31,898 were in the city and immediate suburbs. It has considerable commercial activity, but no special school calculated to prepare young men for it.

The public schools, although numerous enough for the poor, are inefficiently organized, and administered by conflicting authorities, civil, ecclesiastical, and corporate; the statistics may be classified as follows:

I. *Elementary School*.—1 city school for 700 poor children; 15 schools of educational societies with an aggregate of 4,800 pupils. There are numerous private schools, both elementary and secondary, which absorb the interest of the educated and wealthy families.

II. *Secondary and Superior Schools*.—1 gymnasium, founded in 1163, and known as *Catharineum*, with 128 classical scholars, 111 real scholars, and a preparatory section with 82 scholars,—a total of 321 scholars, and 19 teachers; 3 endowed schools, with Latin classes, and 450 pupils. The public library has upward of 50,000 volumes.

III. *Special Schools*.—There are several institutions for orphan and neglected children; and for special classes, but of these we have no information except the

## TRADE SCHOOL AT LUBECK.

The trade school, at Lubeck, dates from 1841, and owes its origin and support to the Lubeck Society for the "Promotion of objects of Public Utility." Its plan is to give such theoretical instruction to apprentices as may be useful to them in their several trades, but it is open to all lads above the age of twelve who intend to enter upon some mechanical occupation, or wish to fit themselves for the agricultural and polytechnic schools, &c. They must be acquainted with the first four rules of arithmetic and write readily from dictation. Most are, in reality, farther advanced than this.

The present head teacher was educated at the Hanover Polytechnic, the others in teachers' seminaries, after having attended the trade school. Their ability to teach is ascertained by examinations and testimonials. They are engaged permanently, but may be dismissed at six months' notice.

No special mode of instruction is prescribed, it being thought that different matters require different methods, and that the individual action of the teachers, in this regard, ought not to be interfered with. The endeavor is to stimulate continually the minds of the pupils, and cultivate independence of thought. All subjects, however, are illustrated by experiments, for which purpose there is a large and increasing stock of apparatus, models, plans, and chemical preparations.

The total number of pupils, in 1867, was 200. The expenses of the school are discharged by the tuition fees, at the rate of about \$5.00 per head, the annual cost of the whole, not including the rent, being \$1,250. Orphans are received free of charge, and the fees for apprentices are sometimes discharged by the masters. The institution has proved itself to be useful, and is well patronized.



## IV. BREMEN.

The free city of Bremen had in 1864 a population of 98,575, on a territory of 106 square miles. Of the entire population, 31,358 live without the city. The city has extensive commercial interests.

The superior administration of the schools is in the hands of the *Scholarchat*, of four members of the senate, each school having a municipal commission or a school delegation.

I. *Public Primary Schools.* *a.* Nine parish schools, with 2,939 pupils, in four classes, both sexes being mingled in the three lower. Each is governed by the *Bauherren* or representatives of the commune, presided over by the pastor. *b.* Nine free schools, with 2,062 pupils, all state institutions, school materials being supplied gratuitously. *c.* Twenty-four private schools, with 2,118 pupils, opened after special permission, and directed by females, who receive half their rent from the state if their annual pay is under 12 thalers. *d.* Two schools of the women's societies, or industrial schools, with 78 pupils. *e.* Asylums for children.

The masters of the parish schools receive from 175 to 500 thalers, with lodging; of the free schools, 180 to 485 thalers. The first masters receive 20 thalers additional every five years, until the whole salary reaches 550. The masters of the free schools are pensioned by the state; of the parish schools, from a special fund. There is also a fund formed by contributions of four thalers from each teacher, which is for the widows and orphans.

*f.* Twenty-four rural schools, mostly over-crowded, with an insufficient number of teachers. They receive an annual subvention of 8,740 thalers.

II. *Higher and Private Schools.* *a.* Gymnasium, 11 teachers, 117 scholars. *b.* Preparatory school, 12 teachers, 278 scholars. *c.* Six private schools, preparatory to gymnasium and burgher schools, 366 scholars. *d.* Four private burgher and real schools, 555 scholars. *e.* Nine higher female schools, private institutions, 648 scholars. *f.* Fifteen elementary schools for children of the wealthier classes, 627 pupils.

III. *Special and Professional Schools.* *a.* Commercial school 15 teachers, 227 scholars. *b.* Teachers' seminary, 30 pupils.

## SCHOOLS FOR THE MILITARY AND COMMERCIAL MARINE.

1. *Military Marine.*

There are in Austria several kinds of naval schools, as follows: One each for sailor boys, for marines, for quartermasters, for naval pupils of the first class, for naval pupils of the second class, a theoretical school for naval cadets, and a superior establishment for naval officers.

1. The school for sailor boys is intended to train, as petty officers for the navy, young men from the Slave and German provinces, admitted between 12 and 14 years of age into the naval service. The instruction lasts until the pupil has attained the age for the conscription; he is then entered as a sailor and becomes a petty officer as soon as he gets sufficiently used to the sea. The highest post he can attain is that of upper boatswain (*Hochbootsmann.*)

2. The schools for marines (*Zeugscorps*) receive men drawn from different corps of the army. They are trained as petty officers, and a part receive the uniform. Those who are fit to become officers receive their promotion when they leave their corps to enter the school.

3. The school for naval cadets of the first class is kept on board a war vessel selected for the purpose. The object is to prepare for the naval service youths of 16 or 18 years of age, who, on entering the school have already received a complete civil technical education. The teaching here consists, therefore, chiefly of practical seamanship, and also of the application of previously acquired scientific knowledge to navigation and nautical astronomy. The course occupies a year; on leaving, the pupil is received as a naval cadet. After passing two or three years at sea these cadets enter the theoretical school for naval cadets.

4. The school for naval cadets of the second class is intended solely to prepare them to become officers. In this school, beside the pupils placed there at the cost of the State, there are others maintained by endowments, and also others who pay for their instruction. The sons of officers and State functionaries are entitled to enter this school at the public expense, and any Austrian subject who has the necessary qualifications is admitted on payment. Foreigners are also admissible as paying pupils, provided they can obtain authorization from their own government to enter the Austrian service. To be admitted, candidates must be between 12 and 14 years of age, of sound health without bodily defect, and able to pass a previous examination. The instruction is given in accordance with a determined plan, on board a vessel prepared expressly to receive the pupils. After three years' instruction the pupils leave the school as naval cadets and are sent to sea. At the end of two or three years' active service the cadets are admitted to the theoretical school. This school receives from 40 to 50 pupils. The chaplain on board is charged with the religious instruction; the other teaching is given by professors from the hydrographic schools. The naval officers of the school-ship give the instruction in practical seamanship.

5. The theoretical school for naval cadets is on shore, and its course occupies a year, after which the pupil undergoes the examination prescribed for his commission as an officer. On leaving this theoretical school the pupils are still naval cadets, but become officers when appointed to a ship.

6. The superior school for naval officers is intended for the further improvement in mathematical and hydrographic studies, of such young men as have shown decided talent and taste for those sciences.



## SPECIAL INSTRUCTION IN HANOVER.

### INTRODUCTION.

THE kingdom of Hanover, before its absorption into Prussia, on an area of 14,846 English square miles, in 1864 had 1,888,070 inhabitants. In the Hartz mountains extensive mining operations are carried on, and the total annual produce is valued at 5,523,885 thalers. Agriculture and the raising of cattle, form, however, the most important sources of income. On the coast, in the rivers, and in 2,500 fish-ponds, a large amount of fish is caught every year. The number of manufactories, mostly linen, was in 1861, 7,141, employing 41,855 people. The trade is largely absorbed by Hamburg and Bremen.

The total annual expenditure in 1864, amounted to 20,066,011 thalers, of which sum 184,000 thalers were expended on public instruction—116,000 thalers on primary, and 68,000 thalers on secondary schools. The institutions of public instruction are administered by the minister of education and ecclesiastical affairs, and embrace :

1. *Primary Instruction.* There are 3,584 primary schools, with 281,348 scholars, and 3,812 teachers.

2. *Secondary Instruction.* There are 8 real schools, with 965 scholars, and 39 teachers; 11 higher burgher schools, with 2,181 scholars, and 112 teachers; 17 gymnasia, with 5,192 scholars, and 205 teachers; 3 progymnasia, with 272 scholars, and 23 teachers; 11 higher girls' schools, with 1,862 scholars, and 107 teachers; making a total of 44 secondary schools, with 10,472 scholars, and 486 teachers.

3. *Superior Instruction.* The University at Göttingen, with 4 faculties, had in 1868, 809 students, and 119 professors.

4. *Special and Professional Instruction.* Eleven teachers' seminaries, with 254 pupils, viz: 1 (preparatory institute) at Hanover, with 32 pupils; 1 (head seminary) at Hanover, with 24 pupils; 1 (after-training) at Hanover, with 12 pupils; 1 (city and county teachers) at Alfeld, with 50 pupils; 1 (boarding seminary) at Lüneburg, with 32 pupils; 1 at Aurich, with 26 pupils; 1 at Stade, with 20 pupils; 1 at Neuenhaus, with 10 pupils; 1 (catholic) at Osnabrück, with 12 pupils; 1 (protestant) at Osnabrück, with 24 pupils; 1 (catholic) at Hildesheim, with 12 pupils. 3 navigation schools; 3 commercial academies; 1 agricultural school; 1 polytechnic school, at Hanover; 1 mining school; 1 school of forestry; 1 military academy; 3 theological seminaries; 1 asylum for the blind, at Hanover, with 75 pupils; 1 institution for the deaf mutes, at Hildesheim, with 120 pupils; 1 do. at Emden, with 25 pupils; 2 with normal schools, at Stade and Osnabrück, with 48 pupils; 1 for imbeciles; 3 rescue houses; 1 Pestalozzi home and refuge; 5 orphan houses; 20 infant schools and gardens.

Since 1866 Hanover forms part of the kingdom of Prussia, constituting the province of Hanover.

## SYSTEM AND SCHOOLS OF SPECIAL INSTRUCTION.

Of the educational institutions of Hanover designed or used to prepare young persons for their special career, and to meet the demands of the public service or of particular industries or special classes, we select a few for brief notice.

## IMPROVEMENT SCHOOLS FOR APPRENTICES.

An apprentice can not become a member of his trade without the approbation of a committee of the guild, over which presides a member of the municipal council. One of the conditions imposed by the committee is evidence of regular attendance on the evening and the Sunday classes established at the expense of the town, and under the supervision of a government board. These improvement classes include drawing and geometry, besides a review of the primary studies. Of these schools there were 37 in 1863, with 170 teachers, 4,077 apprentices, and 3,763 journeymen.

## ARTISANS' SCHOOL AT HANOVER.

Besides the apprentice improvement schools, there exists in the capital a trade or artisan school, with a preparatory class. In the latter, there is an average attendance of 234 pupils, and in the school proper over 600 workmen every year. Drawing constitutes the principal subject of instruction, and in 1864, out of 344 attending to it, 102 were classed as free-hand; 149 special, 67 geometrical and architectural; and 26 from the cast.

## WORKMEN'S SOCIETIES' CLASSES.

Connected with societies of workmen, which exist in the chief towns, there are classes (taught by paid professors) which in Hanover were attended in 1864 by 814 members, of whom more than one-half were taught in different classes of drawing, modeling, and wood-carving.

## REAL AND COMMERCIAL SCHOOLS IN HANOVER.

The real-school was originally established in 1835 for young men whose parents intended them to follow a trade, but it was deemed best to exclude all matters special and technical, and the municipality instituted an independent course of commercial instruction, book-keeping, and kindred subjects, distributed through two years, of four terms of six months each, held four evenings in the week. The merchants' guild selects the pupils who apply, and their masters are bound to give them the necessary time, and to enforce their regular attendance.

## BUILDING TRADE SCHOOL AT NIENBERG.

In Nienberg there is a special school for workmen in the building trades—open in the winter from October 21 to the end of March, and divided into three classes, in which sixty hours a week are devoted by practical masons, joiners, and those pursuing other trades, mainly to technical studies.

LOWEST CLASS.—Compositions in the German language, 8 hours per week; Arithmetic and algebra, 9; Plane geometry, calculation of areas, 7; Linear drawing and descriptive geometry.—jointing roofs, framing, &c., 15; Elements



of physics, 4; Architectural drawing, 5; Free-hand drawing, and ornament, 12—a total of 60 hours for five months.

*Second Class.*—Syntax, punctuation, business letters in German, 4 hours; Algebra, 6; Plane and solid geometry.—Similitude, polygons, the circle, planes, cubature, 4 hours per week; Descriptive geometry.—framing of roofs, vaults, staircases, compound apparatus, parts of machines, shadows, perspective, 8; Technical physics.—forces, effects, centre of gravity, simple machines, 4; Lessons on buildings for stone-cutters, masons, carpenters, slaters, with drawing of plans, sections, elevations, orders, entablatures, details, 21; Lessons on building materials, 3; Drawing of ornaments, from models, 6; Modeling in clay or plaster, wood or stone, 4. Total, 60 hours per week.

*First Class.*—German language.—Written and oral compositions, 2 hours; Manufacturers' book-keeping, 2; Algebra, geometry, plane and solid, (repetitions and exercises,) 4; Practical geometry.—Surveying of land, roads, parts of towns, leveling, plotting, 4; Technical physics.—Machines employed in building, resistance of materials, pressure of water, hoisting machines—Mechanics connected with building, 6; Course on building.—Erection of houses. &c.—Study of ground—Foundations—Establishment of complete projects with estimates—Design of building—Laws affecting buildings, 30; Drawing of ornament, 6; Modeling in plaster and clay, stone and wood, 6 to 12. Total, 60 to 66 lessons per week.

This school, in 1863–64, had 14 professors and 195 pupils, of whom there were 89 masons, 87 joiners, 2 tilers, 9 millwrights and fitters, 7 cabinet-makers, 1 locksmith.

The majority of the pupils were from 17 to 25 years of age; the youngest was 15, and the eldest 37.

#### POLYTECHNIC SCHOOL AT HANOVER.

The first impulse towards the erecting of this institution was given by the old Industrial Club in Hanover, which urged upon the ministers of state (in 1830) the necessity of a technical school. The ministry entered into the idea; caused means to be furnished, and appointed the distinguished Karmarsch, still at its head, to take immediate charge of the school, under the Royal Commissioners of Technical Schools. The first term of the higher industrial school, which name it took, commenced October 3d, 1831. In 1834 the hired buildings proved insufficient, and a new building was begun for its accommodation and completed in 1837, at an expense of \$80,000. A careful choice of teachers, watchful superintendence of the instruction, and a marked progress in the extension of the latter, made this school soon famous, and won confidence, especially in foreign lands. Next to Carlsruhe it has the greatest number of foreigners. In 1847 it received the name of Polytechnic school, which it had really been for a long time.

The aim of the school is in general the same as that of other institutions of the kind, viz., a preparation for technical State service in architecture, railway building, and the making of machinery, as well as to give a scientific education and special studies to those who wish to fit themselves for carrying out scientific and industrial undertakings. The instruction is divided into a preparatory course, and the school proper, which includes the higher special studies.

A comparison can not be instituted between this preparatory course and the general mathematical classes of other schools, since differential and integral calculus is not taught here. In like manner, the school proper is not, as elsewhere, divided into special departments, but the whole course is given in single subjects, more or less of which, according to circumstances, form the scientific education of the pupils for any particular department. To prevent pupils from



taking an unsuitable course of study, certain acquirements are necessary for entering each class, whereby, in an indirect way, a definite course is secured.

To meet the increasing demands for special instruction, additional studies have from time to time been added to the printed announcements, and in these, certain fixed courses are recommended to students for special technical departments.

The chief subdivisions of the teaching are regulated with a view to giving the instruction necessary: 1. For manufacturing chemists; 2. For agriculturists; 3. For surveyors; 4. For mechanics and constructors of machines; 5. For architects; 6. For hydraulic, railway, and road engineers.

To be admitted as a pupil in the preparatory school, candidates must be sixteen years of age, and seventeen for the upper school or for special divisions. The instruction required for the preparatory school comprises the German language and the habit of composition therein, the use of decimal fractions, the rules of three and of proportions, the elements of algebra, plane geometry, and general notions of geography and history. As for the special courses of the superior school, candidates must be masters of the matters taught in the preparatory school, of which we give the details below. However, the pupils who intend to follow only the courses of natural history, are not obliged to undergo an examination in mathematics. No examination is imposed on those who mean to attend only the lessons on drawing and modeling.

*Programme of the Preparatory School.*—Elementary mathematics; algebra as far as equations of the third and fourth degrees; elements of geology and botany; elements of mineralogy; free-hand drawing; linear drawing; elements of descriptive geometry.

*Programme of the Polytechnic School.*—Pure mathematics, in two courses, as far as the calculus of variations; descriptive geometry; practical geometry; mechanics; higher mechanics, theoretical and applied; construction of machines; study of machines; study of prime movers and other machines; building construction, in three courses; roads and railways; bridges and hydraulic constructions; geology, mineralogy, and physical geography; pure physics; applied physics; chemistry, theoretical and applied with manipulation; manual labor, including instruction in working in metals and in wood, spinning and weaving, modeling, and the construction of small models.

To enable the pupils to select the courses which they may attend, and to preclude numerous inquiries, the general regulations state that the preparatory school comprises, in the course of a year, the following subjects: zoölogy, botany, mineralogy, elementary mathematics, free-hand and linear drawing.

The order of the studies, after leaving the preparatory school and for special branches, is shown by the following programme:

FOR CHEMISTS.—*First Year.*—Preparatory school.

*Second Year.*—Theoretical chemistry, technology, theoretical and applied physics and mechanics.

*Third Year.*—Geology and physical geography, or instead, general knowledge of machines and applied chemistry.

*Fourth Year.*—Chemical manipulation.

FOR AGRICULTURISTS.—*First Year.*—Preparatory school.

*Second Year.*—Theoretical chemistry, technology, physics, mechanics.

*Third Year.*—General knowledge of machines, first course of building construction, practical geometry and drawing of plans, or else chemical manipulation, practical chemistry.

FOR SURVEYORS.—*First Year.*—Preparatory school.

*Second Year.*—First course of higher mathematics; theoretical and applied physics; descriptive geometry.



*Third Year.*—Practical geometry with drawing of plans. Geology and physical geography.

FOR MECHANICIANS AND MACHINE-MAKERS.—*First Year.*—Preparatory school.

*Second Year.*—First course of higher mathematics; mechanics, technology, descriptive geometry, theoretical physics.

*Third Year.*—Knowledge of machines, construction of machines, first course of construction, higher mechanics.

*Fourth Year.*—Knowledge of special machines; second course of higher mathematics, pure chemistry, applied physics.

FOR ARCHITECTS.—*First Year.*—Preparatory school.

*Second Year.*—First course of higher mathematics; technology, descriptive geometry, mechanics, theoretical physics.

*Third Year.*—First course of construction and ornamentation, practical geometry and drawing of plans, general knowledge of machines, modeling, drawing from the cast.

*Fourth Year.*—Second course of construction and ornamentation, physical geography, construction of roads and railways, modeling and drawing from the cast.

*Fifth Year.*—Third course of construction and ornamentation, bridges and hydraulic constructions, theoretical chemistry.

FOR CIVIL ENGINEERS.—*First Year.*—Preparatory school.

*Second Year.*—First course of higher mathematics; technology, descriptive geometry, theoretical physics, and mechanics.

*Third Year.*—Second course of higher mathematics; first course of building construction; practical geometry and drawing of plans, construction of machines.

*Fourth Year.*—Road and railways; second course of building construction; higher mechanics, physical geography, and applied physics.

*Fifth Year.*—Hydraulics and construction of bridges, third course of building construction; special machines, and theoretical chemistry.

•The French Commission submit the following observations on the above courses:

The details which have been given show that the order of the teaching is so regulated that, for certain important divisions, such as those of mechanics and architects, pupils may receive a very serviceable amount of technical instruction, with the aid of elementary mathematics, and enter upon the practice of their professions without going through the whole course of studies. Such an arrangement is very suitable for many young men, and in no way injurious to the soundness of their education.

Thus, to enable them to attend the first course of mechanics, the course of construction of machines, those of hydraulics, prime movers, and of the principal machine-tools, and for the drawing up of projects relative to these machines, the mechanical engineers do not require more than the elementary and fundamental principles of geometry, algebra, trigonometry, and descriptive geometry. There is no necessity for them to study the higher pure mathematics, which, notwithstanding their utility, present considerable difficulties to certain minds, and require no little time and effort. The same may be said of the instruction given to architects; for, after attending the first two courses of construction, the pupils may have acquired the knowledge necessary for ordinary buildings.

This gradation of instruction greatly diminishes the inconvenience, above mentioned, of the high reading in the second course of pure mathematics. Moreover, the table showing the distribution of the students among the different branches of learning, which we are about to give, justifies our observations; for it will thereby be seen that whilst 89 pupils are inscribed for elementary mathematics, and 83 for the first course of higher mathematics, there are only 14 for the second course of the same studies. It is therefore more than probable that a small proportion of the 83 pupils of the first course really profit by those lessons.



The pupils were distributed among the different branches as follows:

Elementary mathematics,.....	89	Mineralogy,.....	57
Pure mathematics, { 1st course,.....	83	Geology,.....	40
{ 2d course.....	14	Theoretical physics,.....	24
Mechanics,.....	93	Technical physics,.....	10
Higher mechanics,.....	60	Theoretical chemistry,.....	50
Practical geometry,.....	57	Technical chemistry,.....	27
Descriptive geometry,.....	73	Practical chemistry,.....	29
Study of machines, { 1st course,.....	86	Technology,.....	82
{ 2d course,.....	37	Linear drawing,.....	79
Construction of machines,.....	65	Free-hand drawing,.....	96
Construction of buildings, { 1st course, 79		Drawing from the round and reliefs, ...	10
{ 2d course, 45		Modeling,.....	5
{ 3d course, 27		French language,.....	11
History of the art of building, { ...	39	English language,.....	21
Construction of roads and bridges, { ...	30	History,.....	16
Hydraulic constructions,.....	30	Law and police of buildings,.....	20
Zoölogy and botany,.....	52		

This table clearly shows what courses best suit the requirements of the class of persons who attend institutions of this kind.

They are in the order of the preceding table:—Elementary mathematics; first course of pure mathematics (which might be simplified;) elementary mechanics (which might be extended;) practical geometry; descriptive geometry; the study of machines, first course (which might be made more elementary;) the construction of machines; building construction; zoölogy and botany; theoretical chemistry; technology; linear drawing; free-hand drawing.

It would seem therefore that attention ought to be directed principally to these different branches of learning, and every effort made to facilitate their study by the adoption of the simplest methods. It seems clear that the teaching of the sciences of a high order has a repellent effect on the pupils. That physics should be among the number of the studies least followed is remarkable and much to be regretted. There are, perhaps, particular causes for this, but, in any case, that science ought to hold a higher rank in the programme and to have greater facilities for experimenting.

The number of pupils for the last three years has averaged about 440, of whom 380 were regular—the age ranges from eleven to twenty, a majority being under sixteen years.

There are 21 regular professors, 3 tutors, and several special teachers.

The State pays all expenses over the receipts from tuition, (which amount to about \$6,500 a year,) and supplies the building and equipment.

Prof. Koristka, in his account of the Higher Polytechnic Institutions of Germany, speaks of this school:

The school at Hanover rightly enjoys great reputation in foreign lands. It stands firm by its first organization, which followed closely that of Austria. It is not divided into separate schools, but its whole course is given in single subjects, which are, however, combined in such a way as to give most of the advantages of special schools. Its experience is proof that success depends as much on the excellence and coöperation of the teachers as on organization and courses of study. All the teachers (twenty-four, of whom six have the title of professors and three of assistant-professors) constitute a board, which meets once a month in council and decides on all general rules as to studies and discipline. All submit to the "directory," which is lodged in two persons appointed by the government—one, the principal, is responsible for the finances and the collections, and the other, for the discipline. The general supervision belongs to a royal commission, consisting of the two directors, and four other members. This commission appoints the professors and must visit the class and lecture-rooms, and report annually. Terms in the preparatory school, \$24; and in the Polytechnic there is a fee for each course, which varies according to the length from \$3 to \$16.



## SPECIAL INSTRUCTION IN HESSE-CASSEL.

### INTRODUCTION.

THE Electorate of Hesse-Cassel, on an area of 4,430 English square miles, in 1864 had 745,063 inhabitants. It is chiefly an agricultural and cattle-producing country; factories are only to be found in the larger towns, and these chiefly devoted to linen, and of late years also to cotton fabrics. There are also some paper, glass, iron, and other workshops, and 338 distilleries.

The total annual expenditure of the government of Hesse-Cassel in 1865, amounted to 4,897,680 thalers, of which 90,330 thalers were expended for general instruction. The amount of school-fees is estimated at 60,000 thalers annually.

The institutions of public instruction are administered by the minister of the interior, and under him by the provincial and district authorities, and include:

1. *Primary or Common Schools (Volksschulen).* Of these there were in 1865, about 1,300, of which 117 are burgher and city schools, with about 126,000 scholars, and 1,163 teachers.

2. *Secondary Schools.* 2 Latin schools, with 89 scholars, and 5 teachers; 2 progymnasia, with 128 scholars, and 13 teachers; 6 gymnasia, with 1,333 scholars, and 92 teachers; 10 real schools and higher burgher schools, with 2,254 scholars, and 110 teachers; making a total of 20 secondary schools, with 3,804 scholars, and 220 teachers.

3. *Superior Schools.* The University at Marburg, with four faculties (theology, law, medicine, philosophy), had 50 professors, and 310 students.

4. *Special and Professional Schools.*

3 Teachers' seminaries.

1 Higher industrial school.

1 School of forestry.

1 School of agriculture.

A catholic seminary at Fulda.

A cadet school at Cassel.

An academy of arts at Cassel.

After the war of 1866, the Elector was deposed, and the whole country annexed to Prussia, of which kingdom it now forms, together with Nassau and Frankfort, the province of *Hesse and Franken*.

## SPECIAL INSTRUCTION IN HESSE-DARMSTADT.

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### INTRODUCTION.

THE Grand-duchy of Hesse-Darmstadt, on an area of 3,240 English square miles, in 1864 had 816,902 inhabitants. Hesse-Darmstadt is chiefly an agricultural country; on the Rhine the vine is extensively cultivated, and the region of the Odenwald and the Wetterau are famous for excellent fruit.

The total annual expenditure of the government of Hesse-Darmstadt in 1866, amounted to 9,372,962 florins, of which 44,463 florins were extended for primary instruction, and 28,040 florins for secondary instruction.

The institutions of public instruction, administered by the minister of the interior, embrace:

1. *Primary Schools.* Of these there are 1,756, with 150,568 scholars, and 1,382 teachers.

2. *Secondary Schools.* 6 gymnasia, with 1,171 scholars, and 81 teachers; 10 real schools, with 1,818 scholars, and 110 teachers; 3 higher burgher schools, with 646 scholars, and 29 teachers; making a total of 19 secondary schools, with 3,635 scholars, and 220 teachers.

3. *Superior Schools.* The University at Giessen, with four faculties (theology, law, medicine, and philosophy), had in 1868-9, 45 professors, and 326 students.

4. *Special and Professional Schools.*

2 Teachers' seminaries.

1 School of forestry.

1 Commercial academy.

1 Military academy.

2 Schools of agriculture.

1 School of veterinary surgery.

2 Polytechnic schools.

2 Deaf and dumb asylums.

1 Institution for the blind.



# SPECIAL INSTRUCTION IN MECKLENBURG.

## I. MECKLENBURG-SCHWERIN.

The Grand Duchy of Mecklenburg-Schwerin, on an area of 4,834 English square miles, in 1864, had 552,612 inhabitants, entirely agricultural, the rural population being little removed from the condition of serfs. The trade in corn, cattle, butter, &c., is chiefly carried on by the two ports of Wismar and Rostock.

The total annual expenditure in 1865 was 3,430,028 thalers, of which sum about 30,000 was expended for public instruction.

The institutions of public instruction are administered by the Minister of Education, who at the same time is Minister of Justice and Ecclesiastical Affairs.

1. *Primary Schools*.—There are 1,334 elementary schools and 45 burgher-schools. The exact number of scholars and teachers is not given officially, but by estimation there were in 1864 about 69,000 pupils, under 1,517 teachers.

2. *Secondary Schools*.—There are 5 gymnasia, with 2,083 scholars and 91 teachers; and 8 real-schools and higher burgher-schools, with 1,429 scholars and 62 teachers; making a total of 13 secondary schools, with 3,512 scholars and 153 teachers.

3. *Superior Schools*.—There is 1 university at Rostock, with 4 faculties (theology, law, medicine, and philosophy,) with 38 professors and 171 students.

4. *Special and Professional Schools*:

2 Teachers' seminaries, one at Neukloster with 64 pupils, and a second at Dobberan with 10 pupils.

1 Deaf and dumb institution at Ludwigslust, with 58 pupils.

1 Commercial academy.

1 Military academy.

1 School of agriculture.

3 Nautical schools (Wustrow, Rostock, and Wismar,) with an aggregate of 200 pupils. That at Wustrow has a three years' course, and a preparatory class.

1 School of veterinary surgery.

1 Polytechnic school.

40 Evening trade-schools, for apprentices and journeymen.

## II. MECKLENBURG-STRELITZ.

The Grand Duchy of Mecklenburg-Strelitz, on an area of 997 English square miles, in 1861, had 99,060 inhabitants, who are mainly engaged in agriculture as tenants.

There is only one "Minister of State," who manages all the affairs of the Grand Duchy, including the public schools, viz.:

1. *Primary Schools*.—There are 231 primary schools. The number of scholars and teachers can not be ascertained from official documents, but it is estimated that there were in 1864 about 13,000 pupils, under 250 teachers.

2. *Secondary Schools*.—There are 3 gymnasia, with 814 scholars and 33 teachers; and 4 real and higher burgher-schools, with 1,162 scholars and 33 teachers, making a total of 7 secondary schools, with 1,976 scholars and 66 teachers.

3. *Special and Professional Schools*.—1 Teachers' seminary at Mirow, with 16 pupils; 3 institutions for neglected children, with 65 pupils; 5 industrial schools for girls (teach sewing, &c.) with 95 pupils.

## SPECIAL INSTRUCTION IN NASSAU.

### INTRODUCTION.

THE Duchy of Nassau, on an area of 1,802 English square miles, in 1865 had 465,636 inhabitants. There are considerable iron, lead, and copper, as also a few silver mines, employing about 10,000 men; but more than mining, agriculture employs a large proportion of the population. The vine is cultivated on the banks of the Rhine, and the wines raised in Nassau, (Rüdesheimer, Johannisberger, Hockheimer, &c.,) are considered the best in Germany.

The total annual expenditure of the government of Nassau in 1862, amounted to 5,117,831 florins.

The institutions of public instruction are administered by the minister of state, and embrace:

1. *Primary Schools.* Of these there are 716, with 1,059 teachers, and 72,296 scholars.

2. *Secondary Schools.* There are 3 gymnasia, with 50 teachers, and 711 scholars; 4 progymnasia, with 26 teachers, and 274 scholars; 13 real schools, with 109 teachers, and 1,345 scholars; making a total of 20 secondary schools, with 2,330 scholars, and 185 teachers.

3. *Special and Professional Schools.* Of these there are the following:

2 Teachers' seminaries, 1 for catholic teachers (62), at Montaubaur, and another at Usinglen, for protestant teachers (79).

2 Theological seminaries.

1 Military school.

1 Commercial academy.

1 Agricultural school, at Geisberg, with 35 pupils.

27 Mechanical, or trade schools.

1 Institute for the deaf and dumb.

Since 1866, Nassau has formed part of the kingdom of Prussia, together with Hesse Cassel and Frankfort, constituting the province of *Hesse and Franken.*



## SCHOOLS AND LABORS OF THE GEWERBE-VEREIN.

One of the most important steps of this Society, has been the establishing in various parts of the Duchy, of what are called *Gewerbe-schulen*, or industrial schools. consisting of—

*Firstly*, Evening classes, (*Apend-schulen*), held in winter time for the purpose of giving young Artizans and others an useful complement to their elementary education, in such branches as commercial reckoning and correspondence, and practical geometry.

*Secondly*, Sunday Classes, (*Sontag-schulen*), intended for departments of study which are not so well taught in the evening as by daylight, and held on Sundays for the benefit of young men, chiefly apprentices, whose occupations would not allow them to attend conveniently during the week. They comprise the various branches of drawing required for the industrial trades, and geometry applied to the arts of design.

According to the annual Report, read at the General Meeting of the *Gewerbe-Verein*, on the 11th of May, 1853, by the able Secretary, Dr. Casselmann, the number of Industrial Schools in activity in various parts of the Duchy, is at present twenty-five, with an aggregate number of about two thousand students.

A Modeling School has also been established at Weisbaden, and is attended at present by between thirty-five and forty students.

The Report gives 7419 florins, or about 618*l.* sterling, as the amount expended in the last financial year, for founding and maintaining the above schools, whereof about two thousand florins were furnished by the Society, and four thousand florins were covered by a government grant; the remainder was supplied by the localities.

To secure a proper degree of intelligence and practical skill in all who pursue any trade, there is a legalized system of apprenticeship, which Mr. Twining thus describes.

The would-be Artizan must be able to exhibit proof of having concluded his attendance at school, (which as I have mentioned elsewhere, is obligatory from the sixth to the fourteenth year,) by satisfactorily passing his final examination; he must also have passed his confirmation, which takes place about the same time; it is preceded for a considerable period, by strict religious instruction, and is solemnized by both Protestants and Catholics in a very impressive manner.

If a lad is quite a dunce, and especially if he can not satisfactorily get through his Catechism, he may be retained under tuition another year; or if his vicious propensities are found incorrigible by ordinary means, he may be sent off to a disciplinarian school, called *Rettungs-haus*. One of these establishments was founded in 1851, near the little town of Nassau, by the Countess von Giech, and now contains about ten boys; another has just been erected near Weisbaden by a pious Evangelical Society.

If all is tolerably right, the lad receives in due form his educational certificate, and he and his friends set about looking out for the right sort of shop, and a comfortable master; but before a definite agreement is come to, German prudence steps in very appropriately, and prescribes two weeks' preliminary trial. If this turns out to mutual satisfaction, a contract is drawn up, of which the legalization is obtained with very little expense, or none at all, if the parties are poor.

For ordinary trades, such as those of the shoemaker, tailor, joiner, baker, &c., the usual term is three years, and the total sum to be paid to the master varies from thirty to sixty florins, (\$12 to \$20;) or a term of four years is agreed upon, without payment, the work of the apprentice in the last year being expected to form an equivalent.

With respect to more difficult trades, such as those of the watchmaker, mechanic, lithographer, &c., the term is usually three or four years, with a payment of eighty to two hundred florins, (\$33 to \$40.) Some few trades, requiring little or no technical training, are exceptional with regard to payments; thus apprentices engaged in the operations of building, whitewashing, &c., not only have nothing to pay, but receive at once a daily remuneration of a few *kreuzers*.

In no case does an apprenticeship last longer than four years; serious disagree



ments between masters and apprentices are in some measure obviated by the examination which must be undergone before an artizan can settle anywhere as master ; but in all cases redress is facilitated by the practice of paying the stipulated sum by installments, so that one-third or one-half the amount stands over to the conclusion of the term. If an apprentice has just cause for complaint, he is released by the local authorities from further obligations towards his master, and his friends from further payment.

At the expiration of his term, the apprentice must furnish proof of the extent of his acquirements, by executing some appropriate piece of handiwork, in the presence of the official judges of the trade, forming a kind of jury, which, from its usefulness, deserves some attention.

Every three years the masters in each trade residing in a district, or in a group of districts if the trade is a scarce one, assemble to elect, or re-elect, three representatives for the purpose of examining the certificates, and of testing and recording the abilities of industrial candidates.

If the examiners are not satisfied with the young man's performance, he must find means of improving himself, within half-a-year, against another trial ; if, on the contrary, they are well pleased, he obtains his certificate as *Gesell*, or journeyman, and sets out for his travels.

When the *Gesell* arrives at a town, he goes forthwith to the *Herberge*, or specially appointed inn of his trade, where the *Herberge Vater*, (inn father,) from whom he is entitled to receive paternal attentions and advice, shows him a register, in the form of a slate, or blackboard, on which is inscribed the name of any master wanting a hand. If the register is a blank, and the *Gesell* has no cash in purse from previous savings, he may claim his *Viaticum*, or traveling money, which is either paid from the treasury of the town, or from a subscription purse of the trade, or made up by small donations which he gets at the several workshops of his calling, where he applies in succession for that purpose ; in so doing, he generally makes good his claim to brotherly assistance by some token which he bears, or by mysteriously symbolical signs and passwords, analogous to those used in freemasonry.

At Frankfort, where trade affairs are reckoned to be on a more liberal, or more antiquated footing than elsewhere, an itinerant servant of the proud company of hair-cutters receives from a special purse as much as thirty-six kreuzers, (one shilling ; ) but this may be accounted exceptional, and in the generality of cases, the total amount which a common journeyman obtains by legitimate means, is no more than a few pence. At all events, the sum is definitive ; except in case of illness, no further sum can be claimed, and it will be well if the next morning's dawn sees our wanderer trudging contentedly onward, his knapsack on his back, with a boot sticking out at each end of it, and his faithful pipe dangling at the side of his mouth, whilst he sings some classical ditty of the brotherhood.

There was a time when the industrial vocabulary construed the word *fechten* as a justifiable kind of begging, which did not disgrace a needy journeyman, but now it is inscribed in the black-book of the police ; and if a poor fellow, compelled by sheer necessity, extends an unwilling hand toward a stranger, and a *gend'arme* spies him in the act, he is not only punished with arrest, but this fact is noted down in his pass-book, and subjects him, wherever he goes, to be watched with a suspicious eye, and to increased severity in case of a repetition of the offence.

Before the journeyman can become a *master* in his art, or profession, and fix his abode as such in a place of his choice, a few important steps remain to be taken. If a native of another state, he must obtain the freedom of the one of which he wishes to become a denizen ; if merely of another parish, he must still get admission to parochial rights, which are sometimes expensive : in every case, he is required to accomplish single-handed, for strict inspection by the *Prüfungs Commission*, some model piece of workmanship, sufficient to show, not merely a moderate amount of skill, as when he was a candidate for a journeyman'ship, but his thorough knowledge of the *arcana majora* of his calling. If he can follow up the display orally, with theoretical evidence, he is entitled to be admitted forthwith to the Honorable Company of the Masters of the Trade.



## AGRICULTURAL INSTITUTE AT GEISBERG.\*

The agricultural institute at Geisberg, near Wiesbaden, stands on an elevated plateau, overlooking a most enchanting region of country, with the fashionable invalid resort of Wiesbaden close by, while at a little distance rolls the winding Rhine between its vine-clad hills. The celebrated vineyard of Johannisberg is not far down the river. This school differs from most others in giving instruction only in winter.

It is on the isolated and independent plan, and is designed for the instruction of practical farmers, without teaching practice on the place. Applicants must be sixteen years old, possess a good elementary education, and a good "character." They have to bring a written certificate of willingness on the part of the parent or guardian that they should enter the school, and it is expected that the pupils shall have spent one or more summers in work on the farm, before they enter. If the requisite certificate of proficiency in the elementary studies can not be produced, or if it is not satisfactory, the applicant is examined, and either rejected or accepted with conditions, not unlike the practice in entering Harvard College, where comparatively few get in without "conditions." Each pupil is required to attend all the lectures; but they have a class of pupils, as they have at Hohenheim, called *hospitanten*, or students who take only the partial course.

The theoretical instruction is given in a regular course of two winters, the term beginning on the 15th of October of each year, and ending on the 31st of March. During the intervening summer they are either at home, at work on the farm, or if they desire it, the director of the institute procures them suitable places with skillful practical farmers.

Natives of Nassau pay no tuition. Outsiders pay forty-four florins, or about eighteen dollars a year. All the pupils board in the town of Wiesbaden. The instruction is by lectures and written and verbal questions on the studies. After the return of the students from their summer's work on the farm, they are required within six weeks to present a full written detail of operations, which, after suitable corrections, are returned to the writer.

The parents or guardians are informed, from time to time, of the industry and conduct of the pupil. Gambling, so fashionable and exciting at Weisbaden, is forbidden, and no student is allowed to smoke or to keep a dog.

The institute possesses a library, which appeared to be tolerably well stocked, very good collections and fine lecture and study rooms. It is on rather a small scale as compared with some others, though it may be called one of the superior class. It was founded in 1835, and as may be inferred from what has been said above, on the principle that it is of no use to try to teach theory and practice at the same school. There is a small farm connected with the school, but, judging from the helter-skelter, or generally mixed-up condition of every thing about the premises, I should think they were quite right in not attempting to teach practice there. Old ploughs, drags, carts, harrows and every thing else lay around the buildings in no small confusion. When I drove into the yard I felt sure we had made some mistake, and had got upon the premises of a very slovenly farmer, but the driver was sure he was right, and the result justified his topographical knowledge.

The farm buildings are irregular and crowded, not large or imposing, but rather ordinary in every respect, though the building used by the students and the collections was better.

These collections consisted of minerals, birds, quadrupeds, seeds, grains, and grasses, and a fine collection of wax fruits.

The instruction embraces, in the first term or winter, the German language, arithmetic, botany, mineralogy, physics, general agriculture, cultivation of meadows, rural architecture, and veterinary science. In the second winter the boys take up zoölogy, physics, farm accounts, special agriculture, special zoötechny, horticulture, technology, veterinary medicine and composition.

The price of farm labor there, I learned, was thirty-six kreutzers, or twenty-four cents a day, the men boarding themselves.

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\* Report of C. L. Flint on Agricultural Schools, &c.

## SPECIAL INSTRUCTION IN OLDENBURG.

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### INTRODUCTION.

THE Grand-duchy of Oldenburg, on an area of 2,417 English square miles, in 1864 had 314,416 inhabitants, chiefly engaged in agriculture, with very few engaged in manufactories and other forms of industry. Though favorably situated for maritime commerce, it has but a small seafaring population, and its trade is principally confined to coasting traffic.

The total annual expenditure of the government of Oldenburg in 1865, amounted to 2,386,110 thalers, of which 70,900 thalers were expended for public instruction (46,200 for primary, and 24,700 for secondary instruction).

The institutions of public instruction are administered by the minister of education, who at the same time is minister of the grand-ducal house, of justice, and of foreign affairs.

1. *Primary Schools.* There were in 1865, 490 elementary schools, with 43,174 scholars, and 630 teachers.

2. *Secondary Schools.* There are 10 higher burgher schools, with 1,395 scholars, and 58 teachers; 4 gymnasia, with 644 scholars, and 47 teachers; 1 progymnasia, with 65 scholars, and 10 teachers; making a total of 15 secondary schools, with 2,104 scholars, and 115 teachers.

3. *Special and Professional Schools.*

2 Teachers' seminaries for evangelical teachers, at Oldenburg, with 30 pupils, and another at Vechta, with 20 pupils.

1 Deaf and dumb institute.

1 Military academy.

1 Nautical school, with 30 pupils.

1 Trade school, with 30 pupils.

1 Agricultural school, with 44 pupils.

1 Orphan home, at Varel, with 30 inmates.

7 Infant schools and gardens.



# SPECIAL INSTRUCTION IN PRUSSIA.

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## INTRODUCTION.

THE kingdom of Prussia, on an area of 107,757 English square miles in 1864, (before its recent accession of territory and people,) had a population of 19,269,563, of which number 8,395,418 were engaged in agriculture, 178,903 in mining, 1,067,593 in mechanical and manufacturing pursuits, and 215,078 in commerce.

The total annual expenditure of the government of Prussia in 1865 amounted to 169,243,365 thalers, of which sum 1,865,309 thalers were expended for public instruction, art, and science, in addition to communal and provincial appropriations.

The institutions of public instruction are administered by the Minister of Public Instruction and Ecclesiastical Affairs; the military schools are under the Minister of War; and the special schools of trade, mines, and agriculture, are under the control of the several ministers charged severally with the administration of those interests.

1. *Primary or Common Schools.*—Of these there were in 1864:

25,056 elementary schools, with 36,157 teachers and 2,825,322 scholars.

271 burgher-schools for boys, with 1,171 teachers and 43,731 scholars.

906 licensed private schools, with 1,683 teachers and 52,692 scholars.

205 private schools for boys, with 515 teachers and 8,421 scholars.

239 licensed private schools for girls, with 1,456 teachers and 47,321 scholars.

396 private schools for girls, with 2,161 teachers and 27,593 scholars.

Making a total of 27,073 primary schools, with 43,143 teachers and 3,005,080 scholars.

2. *Secondary Schools.*—There were in 1864:

117 Higher burgher and real-schools, with 1,210 teachers and 27,189 scholars.

28 Progymnasia, with 223 teachers and 3,058 scholars.

147 Gymnasia, with 2,117 teachers and 49,331 scholars.

Making a total of 292 secondary schools, with 3,550 teachers and 79,578 scholars.

3. *Superior Schools.*—In 1864 there were 6 universities [Berlin, Bonn, Breslau, Halle, Königsberg, Greifswald,] each with four faculties, viz., theology, law, medicine, and philosophy, and 1 Catholic academy at Münster with two faculties, viz., theology and philosophy. These 7 institutions have a total of 389 professors and 170 private professors [*privat docenten*,] and 6,077 students. Besides these there were 2 Catholic theological seminaries [Paderborn and Braunsberg,] 1 Protestant theological seminary [Prussian State-church] at Wittenberg, and 1 Moravian theological seminary at Gnadenfeld, Silesia. There are large scientific collections and libraries connected with most of these institutions, and the Royal Library at Berlin numbers upwards of 500,000 volumes and 10,000 manuscripts. The two chemical laboratories at Bonn and Berlin recently erected are the most complete in Europe.

4. *Special and Professional Schools.*

- 60 Teachers' seminaries, [19 Catholic and 41 Protestant,] with about 3,800 students; besides 44 small institutions and classes, which are not recognized as government seminaries.
- 7 Seminaries for secondary school teachers and professors.
- 3 Academies of art [Berlin, Dusseldorf, and Königsberg.]
- 1 Academy of architecture.
- 5 Art and building (*baugewerk*) schools.
- 2 Technical academies or institutes (at Berlin and Cologne.)
- 27 Provincial technical schools, with 2,600 pupils.
- 2-Superior weaving-schools.
- 1 Weaving and pattern-drawing school.
- 265 Industrial schools for mechanics.
- 1 Royal military academy.
- 1 Artillery and engineer-school.
- 5 Cadet-schools.
- 1 Military academy of surgery and medicine.
- 1 Military school of surgery.
- 1 School of veterinary surgery.
- 1 Military school of veterinary surgery.
- 1 Central school of gymnastics.
- 4 Military schools.
- 16 Garrison schools (for soldiers' children.)
- 5 Nautical schools.
- 14 Schools of midwifery.
- 26 Schools for deaf-mutes.
- 10 Schools for the blind.
- 1 Conservatorium and 6 schools of music.
- 34 Schools of agriculture.
- 1 Mining academy (Berlin.)
- 8 Schools of practical mining.
- 6 Schools of commerce.
- 4 Schools of forestry.

The only statistics of Prussian schools since the accession of territory and population in 1866, are for the Secondary Schools, which we give from Dr. Wiese's Report on High Schools for 1869.

## STUDENTS IN SECONDARY SCHOOLS.

	1863.		1868.		
	8 old Provinces.		8 old Provinces.	3 new Provinces.	Total.
<b>I. <i>Gymnasiums.</i></b>					
Regular Classes,.....	42,973		48,977	7,136	56,113
Preparatory Classes,.....	4,046		5,945	1,192	7,137
Total of both,.....	47,019		54,922	8,328	63,250
<b>II. <i>Pro-Gymnasia.</i></b>					
Regular Classes, .....	2,430		2,227	190	2,417
Preparatory Classes, .....	167		205		205
Total of both, .....	2,597		2,432	190	2,622
<b>III. <i>Real Schools.</i></b>					
Regular Classes, .....	18,741		20,741	2,455	23,196
Preparatory Classes,.....	3,362		3,678	839	4,517
Total of both, .....	22,103		24,419	3,294	27,713
<b>IV. <i>Higher Burgher Schools.</i></b>					
Regular Classes, .....	1,991		4,547	4,010	8,557
Preparatory Classes,.....	452		1,172	1,307	2,479
Total of both, .....	2,443		5,719	5,317	11,036
<b>V. <i>Secondary Schools of all kinds.</i></b>					
Regular Classes,.....	66,135		76,492	13,791	90,283
Preparatory Classes, .....	8,027		11,000	3,338	14,338
Total of both,.....	74,162		87,492	17,129	104,621



## SYSTEM AND INSTITUTIONS OF SPECIAL INSTRUCTION.

## SUNDAY SCHOOLS.

Sunday schools, for instructing the young people of a parish in the catechism, and biblical and church history, existed in Prussia and throughout Germany, certainly as early as the sixteenth century, but their recognition as part of the public school system dates from 1763, when Frederick II, in his *General Regulations of Schools* (section 6), ordains that "on Sundays, besides the lesson of the catechism or repetition school given by the minister in the church, the school-master shall give in the school recapitulatory lessons to the unmarried people of the township. They shall there practice reading and writing." In the General regulations for the Catholic schools in Silesia, opened in 1765, "the older children are required to attend the Sunday instruction in Christianity every Sunday afternoon, and after that to participate for two hours in the lessons in reading and writing given in the school, which lessons the teachers shall give under the direction of the pastor, that they may become useful to the young. Those also who have left school, and are not yet twenty years of age, must attend these lessons, and their employers are bound to send them to school at such time, that they may review what they learned before, and acquire necessary knowledge." On this basis of law and habit, by degrees the instruction of the Sunday school was extended and systematized, and became an important portion of the elementary education of the people. In the large villages and cities, drawing, and the first principles of natural history and mechanics, composition in the form of business correspondence, and other branches bearing on the occupations of the pupils, were gradually introduced into this class of schools, which were also held on Monday mornings, in the evening of other days, as well as on the half-holidays of Wednesday and Saturday, and on holidays. They were also connected with the real schools and trade institutes, and got the name of Further Improvement Schools. In Prussia in 1854, there were 220 such schools, with 18,000 pupils; and in Berlin, the trade improvement schools are taught on Sunday by the teachers of the higher schools, and constitute an important agency in the technical instruction of apprentices and workingmen.

## REAL SCHOOLS AND BURGHER SCHOOLS.

The real school, which in Prussia now occupies a well-defined place in the system of general education, had originally a direct technical aim, in the plan of Francke in 1698, and of Semler in 1706 and

1738, and of Hecker in 1747.\* Francke projected a special pedagogium for children, who wished to become "secretaries, clerks, merchants, administrators of estates, or learn useful arts." Semler calls his school "a mathematical trades school," and in the mathematical, mechanical, and economical real school," opened by him in Berlin in 1738, the instruction given was "in connection with models and real objects,"—*things*, as he designates them.

Rev. J. J. Hecker, in the programme of his "Economical Mathematical School," opened in the schools of Trinity church in 1747, he pledges to all his pupils "a preparation to facilitate their entry into any trade they may choose." Among his classes was one of "architecture and building," another of "manufacture, commerce and trade," and another of "agriculture;" moreover, "drawing shall be practiced." The views of Hecker were encouraged by Frederick II, who named his institution the "Royal Real School." This school became the normal school for teachers of schools on the crown domains; and to it, Felbinger sent a number of pupil-teachers, who became the organizers of improved schools in Austria, in which realistic studies and methods were prominent.

In connection with the real school should be mentioned the Higher Burgher School—the high school of the primary system in all large towns, and which received its earliest and highest development in Leipsic, but which in Königsberg, Dantzic, and other large provincial centres, aimed to fit their pupils for practical careers. Both the real school and the higher burgher schools, although they no longer aim to be technical or professional schools, even for a commercial career, do give a scientific preparation for such higher vocations of the State as do not require an academic career, and they also prepare students for the special and purely technical schools. Without them, the subordinate departments of the public service would not be so well filled, and the special schools of trade, commerce, agriculture, and forestry could not attain their present high development.

#### SPECIAL TECHNICAL SCHOOLS.

The immense strides made in mechanical, manufacturing, and commercial industry, and the gigantic works in engineering and construction which the public service in peace and in war have required in the last half century, have made necessary the establishment of special schools, in which architects, builders, machinists, engineers, artillerymen, and technical chemists could be taught and trained. Hence

\* For an account of the educational labors and views of Francke and Hecker, see Barnard's *Educational Reformers of Germany*.



in every State we find government schools for these purposes, and in all the great centres of population and special industries, these institutions are as varied in their independent organization or associated classes, as are the industries and wants to be supplied. Prussia has felt deeply these necessities, and side by side with the thorough reorganization and extension of her general system of education—the multiplication and improvement of primary, secondary, and superior schools—has grown up a system of special instruction—schools of agriculture, forestry, commerce, navigation, architecture, engineering, construction in wood and metal, and trades of all sorts, which will compare favorably with the best in other countries of Europe. Although not as early in the field as some of the smaller States, and not acting with such entire disregard of the general system as some others, in which the manufacturing and mechanical establishments are relatively more numerous and important, this class of institutions in Prussia are worthy of particular study on account of the superior system of general education on which they all rest.

#### TRADE SCHOOLS.

The earliest Trade Schools, (*Gewerbe Schulen*, as they are called, the word *gewerbe* being used in its restricted meaning, equivalent to the improvement of material for the purposes of gain,) in Prussia, were organized by Beuth in 1817–18, at Berlin and at Aix la Chapelle, to meet a want of government for better workmen in building operations. The school at the latter place was expressly founded to improve the general and special education of carpenters, mill-wrights, masons, stone-cutters, cabinet-makers, locksmiths, house-painters, braziers, pewterers, and other handicrafts. They were first connected with the Sunday schools.

Those established at that time were called *Handwerker fortbildung schulen*, and belonged to the class of “improvement schools,” being planned to add to the knowledge of the local handicraftsmen and their apprentices. Schools for special trades or industries did not rise until a few years later. The whole system underwent a reorganization in 1850, when all the establishments of this character were assigned to the Department of the Minister of Commerce.

There are now not far from 500 giving instruction in almost all branches of industrial activity, and all being exclusively devoted to technological studies. The real and burgher schools, (of which there were in 1868, over 190,) through which those pupils who are intending to enter the higher technical institutions generally pass, and

which, moreover, give some instruction in commerce, are not included in this list.

The technical schools may be divided into those imparting general industrial instruction, and those devoted to special branches.

I.—The class giving general instruction embraces the following :

(1.) *Establishments corresponding to Improvement Schools*.—There are a number of varieties of these: the evening, Sunday, and finishing schools; societies for apprentices to which improvement schools are added; journeymen's schools, and workmen's societies, which also make provision for technical instruction.

This class does not carry technical studies very far, except in drawing, the general aim being to extend the knowledge gained in the elementary schools, and nothing more than this is required at admission.

(2.) *Foremen's Schools*.—These aim to train foremen for various mechanical occupations. The institution at Königsberg has 7 teachers and 69 scholars, (1867); the fees are about six thalers per half year. The requirements for admission are the studies of the primary schools.

(3.) *The Provincial and Municipal Trade Schools*.—These two classes of establishments form the next grade in technical instruction, and prepare pupils to enter the central academy at Berlin. They receive those who have had a partial course in the gymnasiums, real schools, or burgher schools. There are in Prussia about 30 of these, averaging four or five teachers, with 2,600 scholars in all. The fees vary exceedingly. There is a journeyman's improvement school connected with each.

(4.) *Central Trade Academies*.—The highest grade of education for mechanics, chemists, and ship-builders is obtained at these establishments, which approaches the character of a polytechnic university. There are now two—the Academy, (*Gewerbe Academie*, formerly called *Gewerbe Institut*), is at Berlin; another, recently organized (1867), at Aix la Chapelle. The Berlin Academy receives scholars who have completed the course at the provincial trade schools, real schools, or the gymnasiums. Of this institution, J. Scott Russell, in his elaborate treatise on systematic technical education for the English people, thus speaks :

Here in Berlin, I found a large and handsome building, close by the king's palace, in one of the best parts of the town, and this was called, at that time, a '*Gewerbe Schule*,' or royal school for trade teaching. This very humble designation did not lead me to expect the high scientific education and training which was there provided for the young professional men of Berlin. The truth is, that in Berlin, everything but the three learned professions, law, medicine, and theology, were still called trades, and not yet admitted to the rank of professions, just as, in our country, the time was when Brindley, the canal engineer, was still



reckoned a sort of superior ditch-digger, and George Stephenson a sort of superior engine-driver. The tradition had still enough influence in Berlin to call a technical university for the modern professions a "trade school."

Since that time, the dignity of the "*Gewerbe Schule*" has been recognized. Its buildings, its endowments, the rank and salaries of its professors, the number and preliminary qualifications of its pupils, have all been raised. It has now the recognized rank of a technical university, with professors of equal dignity, and degrees of equal weight.

Berlin being the first technical university with which I became acquainted, and also one of the earliest, I should naturally quote, as an example of a "technical university abroad," this *Gewerbe Institut*, or *Gewerbe Academie*, of Berlin. I recommend those of my countrymen who care for such things, to visit that institution, which is admirably conducted, systematically organized, and a great boon to the professional men of Prussia. They will find that it in every way lends itself, by means of evening as well as morning lectures, by trade associations connected with it, by free libraries and museums, to the education not merely of the higher professional men, but also of the working men who have leisure and disposition to desire high trade knowledge.

In very many respects, therefore, I consider Berlin a model technical university. I do not quote it, however, as my type of what such a university might be, because it labors under some traditional and local disadvantages, which somewhat narrow its sphere, derange its symmetry, and cramp its development. It is not symmetrical in the highest degree, because in Berlin there had already existed, before it attained its present growth, surrounding institutions, which had monopolized a portion of its ground.

Kindred academies, institutions, or universities, had already provided education and training for some of the arts and professions which a more isolated university would have systematically included in its curriculum; and which it was, therefore, unwise, unnecessary, or inconvenient to include in the new organization. Precisely, therefore, because the Berlin *Gewerbe Academie* fits its place, and answers its special purpose, it is less fitted to serve as a type of a symmetrical institution than some others of more recent growth, more remote from the overshadowing influence of rival and more ancient institutions.

II.—Institutions giving instruction in special professions, include :

1. BUILDING PROFESSIONS: (1.) *Building Schools*.—There are many of these open to all building artisans who have received an elementary education, and imparting theoretical and practical instruction in their special departments. They rank with "improvement schools." The fees are about six thalers per half-year.

(2.) *Building Academy*.—This academy at Berlin educates architects and engineers of the highest grade.

2. MINING PURSUITS: (1.) *Mining Schools*.—These correspond in grade to the provincial industrial schools, and educate foremen and master workmen in the mines.

(2.) *Mining Academy* at Berlin, which gives the highest education in mining and in metal working, and prepares mining engineers.

3. WEAVING AND DYEING: (1.) *Weaver's Schools*.—The weaving schools belong to the grade of improvement schools. There are 3 of them in Prussia, with 12 teachers and 96 pupils in all. The fees are 20 thalers per half-year.

(2.) *Superior Weaving Schools*.—There are 5 superior weaving schools, with 12 teachers. They require the same qualifications as

the provincial industrial schools. The fees are about 20 thalers per half-year.

(3.) *Industrial Drawing School*.—The industrial drawing school at Berlin gives æsthetic and practical instruction to designers for various tissues and to weavers. It is a distinct institution.

4. **COMMERCE**.—Commercial instruction is given to some extent in schools of a general literary aim. Of the special institutions of this class, the school of commerce for young women, at Berlin, deserves attention.

5. **NAVIGATION**.—There are six schools intended to train young men to be pilots and captains of merchant vessels. These are at Memel, Dantzic, Pillau, Grabow, Stettin, and Stralsund.

6. **AGRICULTURE**.—There are thirty-two institutions, in which both the theory and practice of agriculture, and kindred occupations, are taught, and several of them, in the range and thoroughness of instruction, are not surpassed in any country of the world. The work of the school is carried home to neighborhoods by itinerant teachers paid by the government, who go from village to village, and the results of improved methods are seen and disseminated by the action of upwards of five hundred agricultural associations, which by conferences, exhibitions, and prizes, keep up a lively interest in agricultural improvement.

7. The new laboratories, as well for original research as for higher instruction, may be regarded not only as “arsenals” of science, but as mighty engines of industrial development.

The teachers of the lower and middle grades of technical schools become prepared by giving instruction in a gymnasium or real school, and afterwards studying in the Berlin trade academy for three years. Teachers from other schools are also employed, and, in the lowest grades of technical schools, instruction is often given gratis by private manufacturers.

To all of these institutions are attached libraries, and to many belong collections of models, and other aids of instruction; especially full is the collections of the central academy at Berlin.

The result of the system has been to convert workmen into refined and thinking men, and to develop rapidly the industrial resources of the country, as was shown in the late international exhibition at Paris.



## SUNDAY IMPROVEMENT TRADE SCHOOL AT KOENIGSBERG.

The Sunday School of the Society of Industry, (*Gewerbe Gesellschaft*) at Königsberg instructs apprentices in the ordinary trades. It requires no previous practical education, the only requirement being that the candidate has passed through the elementary schools, which implies some rudimentary knowledge of religion and Bible history, German, history, geography, natural history, arithmetic, mensuration, drawing, singing, and gymnastics.

Instruction is given by the professors of the Provincial Trade School in the same city, who receive extra pay for serving. The branches pursued are the following: algebra, arithmetic, gravitation (planimetry and geometry), elementary mechanics and mechanical technology, physics and chemistry in their fundamental doctrines, knowledge of wares and tools, drawing (architectural, machine, free-hand, and geometrical), modeling in clay, wax, wood, &c., book-keeping and business writings.

The course lasts one or two years. There is no charge, the expense being borne by the Society of Industry of the Province of Prussia. There are from 80 to 100 scholars.

## WORKING-MEN'S UNION AT BERLIN.

The Working-Men's Union, at Berlin (*Berlin Handwerker Verein*), stands in the first rank of associations of this class in Germany. It was founded in 1843, dissolved in the revolutionary period of 1848, and again re-organized. It has for its object to promote good morals, general culture, and special professional knowledge among its members. Its doors are open to artisans of all degrees, masters, workmen, and apprentices. Every young man, of good character, can join it on being introduced by a member, and paying a fee of three silver groschen (about seven cents) a month. In its organization is a Committee of Instruction, composed of friends of industry and of the working classes who volunteer their services, among whom are some of the most prominent men in the capital.

The objects of the Society are accomplished by debates, instruction, both general and special, free lectures and social gatherings. The meetings take place four times a week, in the evening, after working hours, and are occupied with study and debating, always ending with choral singing.

**DEBATES.** The debaters are generally members of the Committee of Instruction, the subject being chosen, and the names of the participants published three months beforehand. Between 1861 and 1865, there were 592 such debates, about half of the subjects being questions relating to industry and science. In general, each meeting completes a subject, but sometimes the subject is carried through several in succession. All subjects except politics and religion may be discussed.

**LECTURES.** The lectures are held on the evenings of Monday, Wednesday, Saturday and Sunday. The subjects are very various. In 1867, lectures were given, during the first nine months, on the following subjects, many of them occupying only one lecture: physics, chemistry, technology, natural history, unity of natural forces and agencies, history and mode of lighting with gas, value of machinery, laws of exchange, public law, national rewards, paper money, security of insurance companies, cultivation of industry, manufacturing towns in France, weaving, lace making, calling and position of the female sex, relations of man and wife, of parents and children, woman in literature and in art, sanitary laws,

physiology, anatomy of the intestines, music, history and works of art, history, history of religion, Egmont and Orange, severance of the Netherlands and Spain, literature, trick and romance, lyrics, Goethe's Hermann and Dorothea, Faust, Lessing, Don Juan Fabel, translation of that work, Arkwright, Wedgewood, upon Grabbe and Hebbel, Franz Dunker, Zimmermann and village education, Paris exhibition, Breleck, Born and Ebert's report from Paris, sketches of a journey, German emigration, German life in London, Venice, education, education in the Verein, medicine, domestic economy.

Lectures begin at 8½, and are not to last longer than forty-five minutes, on Monday evenings fifteen minutes. Members of other societies pay one silver groschen; those who do not belong to the societies 2½ groschen. Once a week, on Wednesday evening, each member can bring two ladies, without entrance fee.

The courses of instruction are as follows, the principle of demanding special payment having been adopted after mature consideration :

Studies.	Hours Weekly.	Fee for 3 Months.
1. Calligraphy and reading, - - - -	1	7½ groschen.
2. Orthography " " - - - -	1	10 "
3. German (grammar and reading), - - -	2	10 "
4. " (syntax and reading), - - - -	1	7½ "
5. " (composition and epistolary style), -	1	7½ "
6. Arithmetic.—Course I, - - - -	2	10 "
7. " " II, - - - -	1	7½ "
8. Geometrical and architectural drawing (Sunday morning), - - - -	1	15 "
9. Geometry, - - - -	1	7½ "
10. Book-keeping by single entry, theory of bills of exchange (Sunday morning), - - -	1	1 thaler.
11. Commercial arithmetic (Sunday morning),	1	1 "
12. Book-keeping, double entry, " "	1	15 groschen.
13. Mechanical designing, " "	1	1 thaler.
14. Projection, - - - -	1	7½ groschen.
15. Singing, in two courses, each - - -	1	7½ "
16. Stenography (Sundays), - - - -	1	1 thaler.
17. Modeling, - - - -	1	15 groschen.
18. French (2 courses), - - - -	2	1½ thaler.
19. English (2 courses), - - - -	2	1½ "
20. Pattern reading for weavers (Sunday), -	1	15 groschen.

In pursuance of the purpose of opening classes in special trades, a school for the building-trades has been opened, under the supervision of two architects connected with the Committee of Instruction, imparting the theoretical knowledge necessary for a young artisan in a building-trade, and to enable him to pass the examination for becoming a master in his guild. There are four courses, each occupying four winter months, comprising eight hours of instruction daily. The subjects taught are: German, arithmetic, theory of proportions, algebra, geometry, geometrical projection, elements of physics, theory of mechanical powers, theory of heat, theory of architecture, agricultural architecture, ornamentation, architectural and free-hand drawing and modeling in clay. The fees are from 4 to 6 thalers monthly, but there is a deficit of from 400 to 500 thalers annually, made up by the Union.

The recreations, which may be considered as means, and powerful means, of moral education, are participated in by the female relations of the members. The



days selected for this purpose are Sundays and holidays; the amusements consist of discussions suited to the capacity of the female auditors, concerts, choral singing, dramatic readings, balls and scenic representations, held in the Society's hall, or in a large park outside of the city. Excursions into the country take place often.

There is a savings bank for the members, on the plan of Schulze Delitzsch, and an insurance company affiliated to the great Germania company.

As a minor arrangement of great possible utility may be mentioned the box for questions by workmen on matters pertaining to practical life, or arising from their reading. It is filled every evening, and emptied by the teachers at each successive general meeting.

The Union now numbers 3,000 permanent members, nine-tenths of whom belong to the industrial classes. As many as 10,000 temporary members have been inscribed in one year. The lectures are attended by 10,000 to 12,000 hearers, and the school by 1,300 students, of all grades, apprentices, journeymen, workmen, and masters.

The building of the Union cost, in 1864, together with the land, 68,000 thalers. It is the first in Germany, exclusively devoted to the instruction of workmen. The central hall is 80 feet long, 60 wide and 20 high, and will contain more than 2,000 persons. It opens directly on a garden, the two together affording sufficient room for all the members and their families on festive occasions. Two entire stories are occupied by the lecture-rooms, &c., and the library. The latter is free to all the members, books being exchanged two evenings in the week. The number of volumes (1865) is 3,500, of which from 250 to 500 are taken out weekly. The average number of readers is, in summer 500, in winter 700. There is a great demand for books upon commerce and industry. The reading-room is mostly furnished by the generosity of the editors of the various periodicals, and contains 70 journals, besides political, technical, literary and religious reviews. It is visited by a very large number.

#### PROVINCIAL TRADE SCHOOL AT DANTZIC.

The Provincial Trade School at Dantzic, which may be considered as a fair example of its class, has for its object to instruct commercial assistants and masters or overseers in small manufactories. A further object is the preparing candidates for the polytechnic institutes at Berlin. It is governed by a director, who with four other persons appointed by the provincial government, forms a school committee, regulating the financial and other affairs of the school. The professorships are, one for mathematics, mechanics, engineering, and mechanical technology, one for the natural sciences, namely, physics, chemistry, mineralogy, and chemical technology, and one, with an assistant, for sketching, modeling, and geometrical drawing. The director is one of the two first, the others rank according to seniority. They are considered government officers.

Professors are appointed by the provincial government, after an examination before a special board, but the province may appoint assistants temporarily without this formality. All appointments are to be confirmed by the minister, to whom also the board reports the results of its examinations, and who may dispense with the latter in the case of those who have undergone it at a previous period, or have the reputation of having had experience in giving instruction.

If the candidate has not had practice in teaching, the engagement is made for six months only, but he is definitely settled if he has been in active service for a

period of from three to five years. He is entitled to a pension, his time of service being counted from the date of the beginning of his probation, and a regular annual deduction being made from his salary.

The Minister of Commerce exercises supervision over the plan of instruction to render the system of the provincial trade schools uniform. This plan is forwarded to him every year, in August, together with a detailed report on the condition of the institution from the provincial government.

It receives scholars at fourteen, who can read and write correctly, who have some practice in drawing, can explain any German book within the capacity of their age, "be able to use books for self instruction," and possess a knowledge of arithmetic as far as vulgar fractions, besides being acquainted with the solution of ordinary questions, such as measuring the superficies of polygonal planes and prismatic bodies.

Young mechanics, with only the knowledge acquired in the primary schools, can obtain the necessary preparation in the journeyman's Sunday and evening improvement school, which is connected with the institution. But if it is thought necessary, a preparatory class may be opened, supported by the community, and not as an integral part of the higher establishment; it is also desired that its course be so arranged as to be profitable to those not intending to pursue their studies farther. If such a preparatory class be organized, it is to be provided with a good elementary teacher, and to be under the control of the director of the provincial trade school.

The course lasts two years, and is divided into a junior class for theoretical studies and drawing, and a senior class for application of the instruction received to the different branches of industrial pursuits. The term commences at the beginning of October, and there are only two months vacation in the year. The number of hours of lessons is not to exceed 36 a week; the director gives 16 to 18 hours, the other professors 20 to 24. As the number of scholars in the school is over forty, they are divided, according to the law, into two drawing classes, and an assistant is engaged for the lower class. The curriculum includes the following studies: German composition, arithmetic, with extensive exercises in its practical application, theoretical and applied geometry with practical applications to surveying, algebra, trigonometry, descriptive geometry, conic sections, stereotomy, physics, with strength of materials, mechanics, theory of wheel-works, chemistry and the technology of chemistry, mineralogy as applied to practice, various architectural constructions in the various materials used, geometrical drawing carried to constructing parts of machines from logarithms, free-hand drawing of ornaments, and outline sketches from models, in pencil, ink, chalk, and elpia; finally, clay modeling from plaster casts. There is no religious instruction.

Between the senior and junior classes is an examination. Those failing are allowed to continue in the junior class another year. Any one who can pass this examination is allowed to enter the senior class, whether he has studied in the school or not.

This institution enjoys, as well as some of the other provincial trade schools, the right of issuing certificates after a final examination of those who have completed the course of study. This privilege is obtained, in all cases, after special petition, accompanied with specimen drawings and written exercises from all the members of the senior class. This petition is granted if a favorable report is received by the Minister of Commerce from a commissary sent to examine the class.



The final examination for the "certificates of maturity" is held in July, or at the beginning of August, and is open to all who choose to announce their intention in writing, whether they have been pupils in the institution or not. It is held before a board consisting of a government commissary, the director and the professors of the senior class, and is both written and oral. From the oral part, however, those proposing to engage in certain trades in house-building are excused. Four compositions are to be written under the eye of a professor, without books or aids of any kind; one in four hours, in German, on some subject well known to the pupil that he may have little to do but to arrange his thoughts, and three others to be finished in seven hours each; one on a subject taken from physics, one from chemistry and chemical technology, and one from mechanics and engineering.

Those passing the examination are excused from two of their three years' military service, and may be admitted to the Royal Trade Academy, (*gewerbe academie*,) at Berlin. Like other provincial trade schools, that at Dantzic has the right of conferring a stipend and a free place at the *gewerbe academie*.

There are (1867) 25 in the first and 35 in the second class. Few of these are preparing for the Berlin academy. The fees are 12 thalers a year. It is a day school. The building is furnished by the city, the Government having paid the first expenses of opening it, which amounted to about 4,000 thalers, half of which was for instruments and half for a library and drawing models. The annual cost is shared by the State and the city, and amounts to about 3,200 thalers.

#### SCIENTIFIC AND TECHNICAL SCHOOLS IN BERLIN.

Excellent and useful as are the provincial schools of arts and trades in Prussia, we must look to Berlin and its neighborhood for the most complete development of the system of scientific studies, and facilities for the practical application of the same to national industries, although there is no graded or administrative connection between the institutions. The two schools which give a thorough preparation for the highest special schools, are the Royal Real School, and the City Trade School. The programmes of these excellent schools were drawn up by eminent teachers, assisted by the suggestions of successful business men, and will be found in the following account by Prof. Bache. They are valuable as a general preparation for business life, as well as for the higher training of a polytechnic school.

The Royal Real School, whose history is given in another place,\* as well as the City Trade School, had its origin in the conviction that Latin and Greek were not the only nor the highest objects of study, either for mental discipline, or for the use of pupils who are to grapple with practical problems of life in the public service or in national industries; and its continued work for 100 years has demonstrated the value of modern languages, drawing, mathematics, (including algebra, geometry, and trigonometry), physics, natural history, and chemistry, for the highest purposes for which public schools, for the great majority of the community, are instituted. It was the pioneer institution in that great revolution in pedagogy which has asserted the claims of science in agriculture, architecture, commerce, and manufactures, in modern systems of public instruction.

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\* Special Report of Commissioner of Education on Condition and Improvement of Public Schools in the District of Columbia, 1867-8.—*Appendix.—Notes on the Public Schools of Berlin and Prussia.*



The Frederick William Gymnasium is regarded by Dr. Bache, as a fair specimen of this class of schools in Prussia ; in the organization and instruction of which a good degree of liberty is tolerated by the government, to enable them the better to meet the peculiar circumstances of each province, and the peculiar views of each director.

The Royal Real School, and City Trade School of Berlin, furnish a course of instruction of the same general value for mental discipline, but better calculated for that class of pupils who are destined in life, not for what are designated as the learned profession, but for tradesmen and mechanics. There is less of verbal knowledge but more of mathematics and their application to the arts ; and the whole is so arranged as to facilitate the acquisition of those mental habits which are favorable to the highest practical success.

#### ROYAL REAL SCHOOL OF BERLIN.

The Royal Real School of Berlin was founded as early as 1747, by Counsellor Hecker. At the period in which this school was founded, Latin and Greek were the exclusive objects of study in the learned schools, and the avowed purpose of this establishment was that "not mere words should be taught to the pupils, but realities, explanations being made to them from nature, from models and plans, and of subjects calculated to be useful in after-life." Hence the school was called a "real school," and preserves this name, indicative of the great educational reform which it was intended to promote, and the success of which has been, though slow, most certain.

The successor of Hecker, in 1769, divided this flourishing school into three departments, the pedagogium, or learned school, the school of arts, and the German school: the whole establishment still retaining the title of real school. The first named department was subsequently separated from the others, constituting the Frederick William gymnasium ; the school of arts, and the German, or elementary school, remain combined under the title of the royal real school. The same director, however, still presides over the gymnasium and the real school.

The question has been much agitated, whether the modern languages should be considered in these schools as the substitutes for the ancient in intellectual education, or whether mathematics and its kindred branches should be regarded in this light. Whether the original principle of the "realities" on which the schools were founded, was to be adhered to, or the still older of verbal knowledge, only with a change of languages, to be substituted for it. In this school the languages will be found at present to occupy a large share of attention, while in the similar institution, a description of which follows this, the sciences have the preponderance.

In the royal real school the branches of instruction are—religion, Latin, French, English, German, physics, natural history, chemistry, history, geography, drawing, writing, and vocal music. The Latin is retained as practically useful in some branches of trade, as in pharmacy, as aiding in the nomenclature of natural history, and as preventing a separation in the classes of this school and that of the gymnasium, which would debar the pupils from passing from the former to the latter in the upper classes. It must be admitted that, for all purposes but the last, it occupies an unnecessary degree of attention, especially in the middle classes.

The following table shows the distribution of time among the courses. There are seven classes in numerical order, but ten, in fact, the third, fourth, and fifth being divided into two ; the lower fourth is again, on account of its numbers, subdivided into two parallel sections. Of these, the seventh, sixth, and fifth are elementary classes, the pupils entering the seventh at between five and seven years of age. In the annexed table the number of hours of recitation per week of each class in the several subjects is stated, and the vertical column separating the elementary classes from the others, contains the sum of the hours devoted to each branch in the higher classes, excluding the lower section of the fourth class, which has not a distinct course from that of the other division.



TABLE SHOWING THE NUMBER OF HOURS OF RECITATION PER WEEK, OF EACH CLASS, IN THE SUBJECTS TAUGHT IN THE ROYAL REAL SCHOOL OF BERLIN.

SUBJECTS OF STUDY.	First Class.	Second Class.	Third Class, A.		Third Class, B.		Fourth Class, A.	Fourth Class, B. I. } Fourth Class, B. II. }		Sum of the hours in the seven upper classes.	Fifth Class, A.	Fifth Class, B.	Sixth Class.	Seventh Class.	Proportion of other studies to German in the		
			Royal Real School.	First six classes of the Fred'k Wm. Gymn.	In all the classes of the Fred'k. Wm. Gymn.												
Latin, . . . . .	4	4	4	5	6	5	6	5	6	28					1.4	2.9	3
French, . . . . .	4	4	4	3	3	4	4	4	4	22	4	5			1.1	0.7	0.9
English, . . . . .	2	2	2							6					0.3		
German, . . . . .	3	3	3	4	3	4	4	4	4	20	8	8	10	10	1.0	0.8	1.0
Religion, . . . . .	2	2	2	2	2	2	2	2	2	12	2	3	2	2	0.6	0.6	0.8
Mathematics,* . . . . .	6	6	5	6	7	6	4			35	4	3	6	6	1.7	1.1	1.6
Natural History, . . . . .	3	2	2	2						9					0.4	0.1†	0.1
Physies, . . . . .	2	2	2	2						8					0.4	0.2†	0.2
Chemistry, . . . . .	2	2	2							8					0.4		
Geography, . . . . .				3	3	3	3			9	2	2	2		0.4	0.5	0.5
History, . . . . .	3	3	3	2	2	2	2			15	2	2	2		0.7	0.3	0.7
Drawing, . . . . .	2	2	2	2	2	2	2			12					0.6	0.4	0.4
Writing, . . . . .					2	2	2			4	4	4	6	8	0.2	0.3	0.3
Singing, . . . . .	2	4	3	2	2	2	2			15					0.7	0.6	0.6
Total, . . . . .	36	36	35	35	32	32	32				26	26	26	26			

Pupils who enter this school between five and seven years of age, and go regularly through the elementary classes, are prepared at ten to pass to its higher classes, or to enter the lowest of the gymnasium. It is thus after the fifth class that a comparison of the two institutions must begin. The studies of the real school proper, and of the gymnasium, have exactly the same elementary basis, and they remain so far parallel to each other that a pupil, by taking extra instruction in Greek, may pass from the lower third class of the former to the lower third of the latter. This fact alone is sufficient to show that the real schools must be institutions for secondary instruction, since the pupils have yet three classes to pass through after reaching the point just referred to. It serves also to separate the real schools from the higher burgher schools, since the extreme limit of the courses of the latter, with the same assistance in regard to Greek, only enables the pupil to reach the lower third class of the gymnasium. In general, a pupil would terminate his studies in the real school at between sixteen and eighteen years of age. The difference between the subjects of instruction in the real school and the Frederick William gymnasium, consists in the omission in the former of Greek, Hebrew, and philosophy, and the introduction of English and chemistry. The relative proportions of time occupied in the same subjects in the two schools, will be seen by comparing the two columns next on the right of the numbers for the seventh class, in the table just given. The first of these columns contains the proportion of the number of hours per week devoted to the different subjects in the six classes of the real school above the elementary, the number of hours devoted to the German being taken as unity; and the second, the same proportion for six classes of the gymnasium, beginning with the lowest, the same number of hours being taken as the unit, as in the preceding column. To bring the natural history and physies into comparison, I have taken the numbers for the

\* Including arithmetic, geometry, algebra, and trigonometry.  
 † These numbers include the entire course.



upper classes of the gymnasium in which these branches are taught. Of the courses common to the two schools, those to which nearly equal attention is paid in both institutions, are—the religious instruction, the German, geography and history, writing, and vocal music. The French, mathematics, physics, and natural history, predominate in the real school, the Latin in the gymnasium. The effect of reckoning the first, second, and upper third classes of the gymnasium, does not materially change the proportionate numbers of the courses which are common to the two schools, except as to Latin and mathematics. To show this, the column on the extreme right of the table is introduced, containing the proportions for all the nine classes of the Frederiek William gymnasium.

There were, in 1838, five hundred and ten pupils in this real school, under the charge of fourteen regular or class masters, teaching several subjects in the lower classes, and of six other teachers. Each of the eleven class divisions thus averages about forty-six, who are under the charge of one teacher at a time.

The elementary course in the real school is similar to that described in the burgher schools, beginning with the phonic method of reading, the explanations of all the words and sentences being required at the same time that the mechanical part of reading is learned. Written and mental arithmetic are taught together in the lowest class. The religious instruction consists of Bible stories adapted to their age; and verses are committed to improve the memory of words. The exercises of induction are practiced, but in a way not equal to that with objects, introduced by Dr. Mayo in England. Some of the pupils are able to enter the gymnasium after going through the two lowest classes.

In regard to the real classes proper, as I propose to enter into the particulars of the course of study of the trade school, I shall here merely make a few remarks upon two of the branches studied in them, namely, French and drawing. The remarks in regard to the French will serve to show how great a latitude a teacher is allowed in the arrangement of his methods, the result of which is, that those who have talent are interested in improving their art by observation and experiment. The French teacher to whom I allude had been able to secure the speaking, as well as the reading, of French from his pupils. From the very beginning of the course this had been a point attended to, and translation from French into German had been accompanied by that from German into French: the conversation on the business of the class-room was in French. The pupils were exercised especially in the idioms of the language in short extempore sentences, and the differences of structure of the French and their own language were often brought before them, and the difficulties resulting from them anticipated. Difficult words and sentences were noted by the pupils. Declamation was practiced to encourage a habit of distinct and deliberate speaking, and to secure a correct pronunciation. The chief burthen of the instruction was oral. Without the stimulus of change of places, the classes under this gentleman's instruction were entirely alive to the instruction, and apparently earnestly engaged in the performance of a duty which interested them. If such methods should fail in communicating a greater amount of knowledge than less lively ones, which I believe can not be the case, they will serve, at least, to break down habits of intellectual sloth to promote mental activity, the great aim of intellectual education.

The drawing department of this school is superintended by a teacher who has introduced a new method of instruction, particularly adapted to the purpose for which drawing is to be applied in common life and in the arts; a method which is found to enable a much larger proportion of the pupils to make adequate progress than the ordinary one of copying from drawings.\* In this method the pupil begins by drawing from simple geometrical forms, those selected being obtained from models in wood or plaster, of a square pillar,† a niche, and a low cylinder, (the form of a mill-stone.) The square pillar separates in joints, affording a cube and parallelopipeds of different heights. The hemisphere which caps the niche may be removed, leaving the concave surface of its cylindrical part. The exercises of the pupil ran thus: First, to place upon a board, or upon his paper or

\* Mr. Peter Schmidt, who now, in his old age, has received from the government a pension in return for the introduction of his method, and the instruction in it of a certain number of teachers.

† Seven and a half inches high, and one inch and a half in its square section.



slate, a point vertically above another, or so that the lines joining the two shall be parallel to the right or left hand edge of the board, paper, or slate. Second, to join them. Third, to place a point horizontally from the second, and at a distance equal to that between the first and second points. Fourth, to place one vertically over the third, and at a distance equal to that below the first, and to join the third and fourth. The first and fourth being then joined, a square is formed. After practice in this, the simple elevation of the cube is drawn. Next, a perspective, by the use of a small frame and silk threads, such as is common in teaching the elements of this subject, and by means of which the pupil acquires readily a knowledge of the practice. The drawing of lines in various positions, and with various proportions, terminates this division of the subject. The niche and cylinder afford a similarly graduated series of lessons on the drawing of curved lines, and the drawing of lines of different degrees of strength and of shadows is introduced. This is accompanied with some of the more simple rules of shadow and shade. More difficult exercises of perspective follow from natural objects and from works of art or mechanism, according to the direction to the pupil's attainments and the amount of taste which he displays. This method of teaching has been introduced quite generally in Prussia, and with the best results as to the formation of accuracy of eye and of hand.

## CITY TRADE SCHOOL.

The City Trade School was founded to give a more appropriate education for the mechanic arts and higher trades than can be had through the courses of classical schools. It is a great point gained, when the principal is admitted that different kinds of education are suited to different objects in life; and such an admission belongs to an advanced stage of education. As a consequence of a general sentiment of this kind, numerous schools for the appropriate instruction of those not intended for the learned professions grow up by the side of the others.

The city of Berlin is the patron of the trade school which I am about to notice, as the king is of the real school already spoken of. Its stability is thus secured, but the means of furnishing it with the necessary materials for instruction are liberally provided.\* The trade school is a day school, and consists of five classes, of which the lowest is on the same grade as to age and qualification at admission, as the fourth class of a gymnasium. It is assumed that at twelve years of age it will have been decided whether a youth is to enter one of the learned professions, or to follow a mechanical employment, or to engage in trade, but the higher classes are not closed against pupils. Of the five classes, four are considered necessary for certain pursuits and the whole five for others; the courses of all but the first class last one year, that of the first, two years, a youth leaving the school at from 16 to 17 or 18 years of age, according to circumstances. During the year 1836-7, the number of pupils in the several classes were, in the first class, eleven; in the second, twenty-nine; in the upper third, forty-three; in the lower third, fifty-two; in the fourth, fifty; total, one hundred and eighty-five; from which numbers it appears that a considerable proportion of the pupils leave the school without entering the first class. The number of teachers is nineteen, five being regular or class teachers, and fourteen assistants. The director gives instruction.

The following list of the callings to which pupils from this school have gone on leaving it, will show that it is really what it professes to be, a school for the instruction of those who intend to follow occupations connected with "commerce, the useful arts, higher trades, building, mining, forestry, agriculture, and military life;" and further, that its advantages are appreciated by the class for whom it is intended. The list includes the pupils who have left the school from the first and second classes, in the years 1830, 1832, 1833 and 1837. From the first class, two teachers, five architects, one chemist, twenty-six merchants, one machinist, two calico-printers, two glass-workers, one cloth manufacturer, one silk manufacturer, one miner, thirteen agriculturalists, eight apothecaries, two gardeners, one painter, one mason, one carpenter, one tanner, one miller, one baker, one potter, one saddler, one soap-boiler, one cabinet-maker, two soldiers, one musician, five to

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\* The present director of this school, Mr. Kloden, was formerly director of the higher burgher school at Potsdam, and is one of the most distinguished teachers in his line in Persia.



public offices, one to the trade institution, six to gymnasium. From the second class, forty-one merchants, one teacher, one chemist, one machinist, one ship-carpenter, nine agriculturist, one sugar-refiner, three dyers, one tanner, one brewer, two distillers, one miner, two lithographers, one dye-sinker, three apothecaries, one dentist, two painters, two gardeners, three masons, five carpenters, one miller, four bakers, one butcher, one to the trade institution, three to public offices, two to a gymnasium, one musician, one veterinary surgeon, one soldier, being ninety from the first class, and ninety-seven from the second, in the period of four years.

In the course of instruction, the sciences and kindred branches are made the basis, and the modern languages are employed as auxiliaries, the ancient languages being entirely omitted. The subjects embraced in it are—religious instruction, German, French, English, geography, history, mathematics, physics, chemistry, technology, natural history, writing, drawing, and vocal music.

The courses are fully laid down in the following list, beginning with the studies of the lowest or fourth class.

#### FOURTH CLASS.

*Religious Instruction.\** The gospel according to St. Luke, and the Acts of the Apostles explained, with a catechetical development of the truths of religion and ethical applications. Two hours per week.

*German.* Grammatical exercises in writing. Recital of poetical pieces.

*French.* Grammatical exercises. Regular and irregular verbs. Reading from Lauren's Reader. One hour of conversation. Four hours.

*Arithmetic.* Mental and written, including proportions and fractions, with the theory of the operations. Four hours.

*Geometry.* Introductory course of forms. Two hours.

*Geography.* Elementary, mathematical, and physical geography. Two hours.

*Natural History.* In the summer term, elements of botany, with excursions. In the winter, the external characters of animals. Two hours.

*Physics.* Introductory instruction. General properties of bodies. Forms of crystals, specific gravity, &c. Two hours.

*Writing.* Two hours.

*Drawing.* Outline drawing and shadows, from models and copy-boards. Two hours.

*Vocal Music.* Two hours.

#### LOWER THIRD CLASS.

*Religious Instruction.* The Acts of the Apostles and the Epistles read and explained. Two hours.

*German.* Grammar with special reference to orthography and etymology. Written exercises upon narrations made by the teacher. Delivery of poetical pieces. Four hours.

*French.* Translation from French into German from Gredicke's Chrestomathy. Grammar; irregular verbs. Extemporalia, and translations from German into French. Four hours.

*Arithmetic.* Partly abstract, partly practical, from Diesterweg's Instructor. Four hours.

*Geometry.* Determination of angles in triangles and polygons. Equality of triangles. Dependence of angles and sides of triangles. Constructions. Three hours.

*Geography.* Physical description of the parts of the earth, except Europe. Two hours.

*Natural History.* Mineralogy. In summer, botany, the class making excursions for practical exercise. Man. Three hours.

*Physics.* General properties of bodies and solids in particular. Doctrines of heat and their application to natural phenomena and the arts. Two hours.

*Chemistry.* Introduction. Atmospheric air. Experimental illustrations of chemistry, applied to the arts. Two hours.

*Writing.* Two hours. *Architectural and topographical drawing.* Two hours. *Drawing* by hand for those who do not take part in the other. Two hours.

*Vocal Music.* Two hours.

#### UPPER THIRD CLASS.

*Religious Instruction.* Christian morals, from Luther's Catechism. Two hours.

*German.* Simple and complex sentences. Compositions on special subjects. Poems explained and committed. Four hours.

*French.* Translation from Gredicke's Chrestomathy, oral and in writing. Written translations from Beauvais' Introduction, from German into French. Grammar, examples treated extempore. Four hours.

*Arithmetic.* Properties of numbers. Powers. Roots. Decimal fractions. Practical Arithmetic from Diesterweg. Four hours.

*Geometry.* Similar figures. Geometrical proportion. Exercises. Mensuration of rectilinear figures. Three hours.

*Geography.* Physical geography of Europe, and in particular of Germany and Prussia. Two hours.

*Natural History.* Continuation of the mineralogy of the lower third class. Review in outline of zoology and the natural history of man in particular. Botany, with excursions in summer. Three hours.

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\* Roman Catholic pupils are not required to take part in this instruction, which is communicated by a Protestant clergyman.



*Physics.* Electricity and magnetism, with experiments. Two hours.  
*Chemistry.* Water and non-metallic bodies, with experiments. Two hours.  
*Writing.* Two hours. *Architectural and topographical drawing.* Two hours. Some of the pupils during this time are engaged in ornamental drawing.  
*Vocal Music.* Two hours.

## SECOND CLASS.

*Religious Instruction.* Explanation of the first three gospels. History of the Christian religion and church to the reformation. Two hours.  
*German.* Correction of exercises written at home, upon subjects assigned by the teacher. Oral and written exercises. Introduction to the history of German poetry. Three hours.  
*French.* Grammar; extemporalia for the application of the rules. Written and oral translations from German into French, from Beauvais' Manual, and vice versa, from Ideler and Nolte's Manual. Four hours.  
*English.* Exercises in reading and speaking. Translation into German, from Burkhardt. Dictation. Verbs. Two hours.  
*Arithmetic.* Commercial Arithmetic. Algebra, to include simple and quadratic equations. Logarithms. Three hours.  
*Geometry.* Circles. Analytical and plane trigonometry. Three hours.  
*Geography.* The states of Europe, with special reference to their population, manufactures and commerce. Two hours.  
*History.* Principal events of the history of the middle ages and of later times, as an introduction to recent history. One hour.  
*Natural History.* Mineralogy. Physiology of plants. Three hours.  
*Chemistry.* Metallic bodies and their compounds, with experiments. Three hours.  
*Architectural, topographical, and plain drawing.* Drawing with instruments. Introduction to India ink drawing. Beginning of the science of constructions. Two hours.  
*Drawing.* From copies, and from plaster and other models. Two hours. This kind of drawing may be learned instead of the above.  
*Vocal Music.* Two hours.

## FIRST CLASS.

*Religious Instruction.* History of the Christian religion and church continued. References to the bible. One hour.  
*German.* History of German literature to recent times. Essays. Exercises of delivery. Three hours.  
*French.* Reading from the manual of Buchner and Hermunn, with abstracts. Classic authors read. Review of Grammar. Exercises at home, and extemporalia. Free delivery. Correction of exercises. Four hours.  
*English.* Syntax, with written and extempore exercises from Burkhardt. Reading of classic authors. Writing of letters. Exercises in speaking.  
*Arithmetic.* Algebra. Simple and quadratic equations. Binomial and polynomial theorems. Higher equations. Commercial arithmetic continued. Three hours.  
*Geometry.* Plane trigonometry and its applications. Conic sections. Descriptive Geometry. Three hours.  
*History.* History of the middle ages. Modern history, with special reference to the progress of civilization, of inventions, discoveries, and of commerce and industry. Three hours.  
*Natural History.* In summer, botany, the principal families, according to the natural system. In winter, zoology. The pupils are taken, for the purpose of examining specimens to the Royal Museum.  
*Physics.* In summer, optics with experiments. In winter the system of the world. Three hours.  
*Technology.* Chemical and mechanical arts and trades, described and illustrated by models. Excursions to visit the principal workshops. Four hours.  
*Architectural and machine drawing.* Two hours. Those pupils who do not take part in this, receive lessons in ornamental drawing from plaster models.  
*Vocal Music.* Two hours.  
 The pupils of this class are, besides, engaged in manipulating in the laboratory of the institution several hours each week.

The courses require a good collection of apparatus and specimens to carry them out, and this school is, in fact, better furnished than any other of its grade which I saw in Prussia, besides which, its collections are on the increase. The facilities for the courses are furnished by a collection of mathematical and physical apparatus, a laboratory, with a tolerably complete chemical apparatus and series of tests, a collection of specimens of the arts and manufactures (or technological collection,) a collection of dried plants, and of engravings for the botanical course, and a small garden for the same use, a collection of minerals, a collection of insects, a collection in comparative anatomy, a series of engravings for the drawing course, and of plaster models, a set of maps, and other apparatus for geography, some astronomical instruments, and a library. The pupils are taken from time to time, to the admirable museum attached to the university of Berlin, for the examination of zoological specimens especially.

That this school is as a preparation for the higher occupations, and for professions not ranking among the learned, the equivalent of the gymnasium is clearly shown by the subjects and scope of its courses, and by the age of its pupils.

Some of these occupations require no higher instruction, others that the pupils shall pass to the special schools introductory to them. So also, many of the pupils of the gymnasia pass at once into active life, others enter the university.

The class of schools to which the two last described belong, are most important in their influence. In many countries, an elementary education is the limit beyond which those intending to enter the lower grades of the occupations enumerated in connection with the City Trade School of Berlin, do not pass; and if they are inclined to have a better education, or if intending to embrace a higher occupation, they desire to be better instructed, they must seek instruction in the classical schools. The training of these schools is, however, essentially different from that required by the tradesman and mechanic, the verbal character of the instruction is not calculated to produce the habits of mind in which he should be brought up, and the knowledge which is made the basis of mental training is not that which he has chiefly occasion to use. Besides, were the course ever so well adapted to his object, the time at which he must leave school only permits him to follow a part of it, and he is exposed to the serious evils which must flow from being, as it were, but half taught.

In fact, however, he requires a very different school, one in which the subjects of instruction are adapted to his destination, while they give him an adequate intellectual culture; where the character of the instruction will train him to the habits which must, in a very considerable degree, determine his future usefulness; and where the course which he pursues will be thorough, as far as it goes, and will have reached before he leaves the school the standard at which it aims. Such establishments are furnished by the real schools of Germany, and as the wants which gave rise to them there, are strongly felt every where, this class of institutions must spread extensively. In Germany they are, as has been seen, no new experiment, but have stood the test of experience, and with various modifications to adapt them to differences of circumstances or of views in education, they are spreading in that country. As they become more diffused, and have employed a greater number of minds in their organization, their plans will no doubt be more fully developed.

It is certainly highly creditable to Germany that its "gymnasia," on the one hand, and its "real schools" on the other, offer such excellent models of secondary instruction in its two departments. The toleration which allows these dissimilar establishments to grow up side by side, admitting that each, though good for its object, is not a substitute for the other, belongs to an enlightened state of sentiment in regard to education, and is worthy of the highest commendation

DISTRIBUTION OF STUDIES IN THE CITY TRADE SCHOOL OF BERLIN.

SUBJECTS OF INSTRUCTION.	NO. OF HOURS PER WEEK.					Total.
	First Class.	Second Class.	Upper Third Class.	Lower Third Class.	Fourth Class.	
Religion, .....	1	2	2	2	2	9
German, .....	3	3	4	4	4	18
French, .....	4	4	4	4	4	20
English, .....	2	2				4
Arithmetic, .....	3	3	4	4	4	18
Geometry, .....	3	3	3	3	2	14
Geography, .....		2	2	2	2	8
History, .....	3	1				4
Natural History, .....	2	3	3	3	2	13
Physics, .....	3		2	2	2	9
Chemistry, .....		3	2	2		7
Technology, .....	4					4
Writing, .....			2	2	2	6
Drawing, .....	4	4	2	2	2	14
Vocal Music, .....	2	2	2	2	2	10
Total, .....	34	32	32	32	28	



## THE ROYAL TRADE ACADEMY IN BERLIN.

The Royal Trade Academy (*Königliche Gewerbe Academie*), formerly the Royal Trade Institute (*Institut*), at Berlin, was founded in 1821, and underwent a re-organization in 1849.

Its object, according to the terms of a circular of 1860, is "to give the student an opportunity to qualify himself for the position of a superintendent or owner of a technological establishment." It stands at the summit of technical instruction. It may be considered, together with the building and mining academies, of which a description is given elsewhere, as a polytechnic school.

The institution is in the department of the Minister of Commerce, Industry and Public Works. It is governed by a Council of Studies, composed of a high official of the Bureau of Commerce, Industry and Public Works, of the director of the academy as his substitute, of two professors of the school, and of two other gentlemen "as independent representatives of science and industry." All the interests of the institution, and all changes in its organization, are deliberated upon by this Council, and the results of its deliberations laid before the Ministry. The immediate management is in the hands of the director already mentioned. He is not a teacher. There are ten titular professors, and twelve other teachers. Most of the former fill professorships in other establishments, as in the University. The teaching corps forms a board, called together at the close of the term to a school conference on the order of classes. There is also in this institution a class of instructors called *Privatdocenten*, receiving fees from their private pupils, but no salary from the government. They must have completed the three years' course, and have been in practice as competent engineers.

The conditions of admission are as follows: 1. The candidate must be between 17 and 27 years of age, and must bring a certificate of birth to prove this. 2. He must present a certificate of maturity from a provincial trade school, from a first class real school, or from a gymnasium. 3. Students in the shipbuilding division must prove that they have been engaged, for at least one year, in practical work in the shipyard of a seaport, before they can go on in the special studies of their profession. The requirement of one year's practical work was originally made from all candidates, but it was repealed, because a great part of what had been acquired at the gymnasium was often forgotten during the interval. In the case of shipbuilders, however, the year's experience is absolutely necessary.

The period of instruction is three years, with six half-yearly terms. Of these, the first three, Section A, are occupied with general and purely theoretical technical studies, for all the students in common. During the last three, Section B, special courses are pursued, and practical exercises are added. The special departments are:

- I. Special technology, as mechanics.
- II. Chemistry and metallurgy.
- III. Ship-building.

The studies of Section A are obligatory on all, but those students of chemistry who aim only at being assistants in factories. It is thought that "those having this modest object in view, can do very well without the mathematics of the third term, and will employ their time more usefully in the laboratory. The director may, therefore, allow that class of chemists to experiment in the laboratory after having attended the lectures in the first theoretical section for one year." Those

intending to establish or superintend chemical factories, must go through the whole course. The period of study can be prolonged by students of mechanics, who are allowed to spend an additional year in the workshops connected with the institution.

The academical year begins October 1st, and closes August 15th, with a vacation of ten days at Christmas, and one of the same length at Easter.

In regard to the studies pursued, we extract from the circular of August 23, 1860, already cited, the following paragraph, which shows the admirable spirit in which they are planned :

The characteristic peculiarity of the course of instruction is this, that the students do not obtain the knowledge necessary to their future career by a series of lectures, independent of one another, as at the University, but that the lectures form a complete and well organized course, intimately connected with each other, and so arranged that the student passes through all the theoretical and practical branches of science and art, step by step from the moment he becomes a member of the second section to the time when he leaves the Institute. This is the reason why teachers and students are not permitted to select the objects of teaching and study, that the students are obliged to pass through the general theoretical section, and that the professors must arrange their lectures in harmony with the general plan of the Institute. Free choice is, however, allowed within certain specified limits.

The curriculum, which has undergone many changes, is as follows :

#### A. IN THE GENERAL TECHNOLOGICAL SECTION.

- a. Complement to general knowledge of figures ; higher equations.
- b. Spherical trigonometry.
- c. Differential and integral calculations.
- d. Analytical statics and mechanics.
- e. Theory of mechanical effects of heat.
- f. Descriptive geometry, and application of it to perspective construction of shadows and lithotomy.
- g. Special inorganic chemistry.
- h. Physics.
- i. General experimental chemistry.
- k. General knowledge of constructive building.
- l. Knowledge of simple machines.
- m. Drawing.
- n. Modeling.

#### B. IN THE SPECIAL TECHNOLOGICAL SECTION.

##### I.—*For mechanicians :*

- a. Theory of solidity of buildings, and of parts of machinery ; calculations with regard to buildings put together ; theory of Aronc's counterpoise ; and (*Futter mauern*) building of sluices.
- b. Motion of water and air in natural and artificial ducts ; practical hydraulics ; theory of heating apparatuses ; fireplaces.
- c. General theory of machines ; their resistance and regulation, particularly the theory of hydraulic motors and steam engines.
- d. Calculations with regard to simple parts of machinery ; general principles of their construction.
- e. Details of machines ; power machines.
- f. Mechanical technology.
- g. Chemical technology.
- h. Practice in plans of parts of machines, and whole machines.
- i. Practice in plans of power machinery.
- k. Practice in plans of machines and factory grounds.
- l. Plans and drawings of such artistic forms as can be executed in cast iron.
- m. Mathematical foundation of the most important physical laws.



II.—*For chemists and smelters :*

- a. Special inorganic chemistry.
- b. Special organic chemistry.
- c. Mineralogy.
- d. Geognosy.
- e. Metallurgic chemistry.
- f. Chemical technology.
- g. Special knowledge of machines and machine power.
- h. Practice in planning chemical works.
- i. Practical studies in the laboratory.

III.—*For ship-builders :*

- a. (up to i) as in II. 1.
- k. Drawing of vessels and parts of vessels.
- l. Art of ship-building, general displacement and stability, first part; hydrostatic calculations.
- m. Art of ship-building, knowledge of stability, second part; theory of sailing and steam vessels, general principles with regard to form of vessels; knowledge of construction of wooden and iron vessels.
- n. Practice.
- o. Planning and calculating cost and capacity of vessels.

At the close of every term a review of the studies pursued during the term is held. This review, which is a kind of examination, and is called "repetition," is obligatory only upon the stipendiaries, and that class of students who avail themselves of the free places in the school.

On leaving the Academy, the student receives a certificate, signed by the council of teachers; it enumerates all the lectures and practical exercises he has attended; reports his standing in the repetitions and adds a critique on the skill and judgment displayed by him in the practical department.

There is a fine collection of models, which has recently been re-arranged and newly classified. They are in bronze, and plaster of Paris, and consist of models of ornaments and of the plastercasts for the drawing class, models for wood and cotton manufactures, and some illustrating descriptive geometry. Most of them were made at the school. There is a rich collection for machinery and mechanical technology. The library is open to the public at stated hours. The pupils can use the collections under certain restrictions.

There is a laboratory for organic chemistry, with room for 50 pupils, and one for inorganic chemistry with room for 20.

The reagents are arranged on tables, each large enough for six pupils, and provided with eupboards and shelves. Evaporating processes are carried on in glazed and closed stoves, with gas burners, and hot sand baths, the whole well closed and ventilated.

The workshops connected with the academy are more extensive than at any other technical establishment, and not only give practical instruction in mechanics and ship-building, but encourage the construction of new machines, and manufacture models for the drawing-school, and for general industrial uses. There are consequently always a certain number of regular workmen employed in them. The pupil begins with the making of a screw, and proceeds in regular order to the most difficult mechanical operations, for which the large machines and monuments made here afford a good opportunity.

The number of pupils in the Academy was 440 in 1867. In 1861-62 there were 374 pupils, of whom 67 were mechanics, 20 chemists, and 3 ship-builders. The fees are twenty thalers per half year; forty-five thalers for those who work

practically in the chemical laboratory, and the student must pay for all breakages, &c., caused by his negligence. For practical work in the workshops, the fee is one thaler per half year; for work in the photographic atelier once a week, two thalers per half year. Masters of establishments, workingmen's unions, &c., often pay these fees for gifted young men whom they send.

The institution has a large number, 150 in all, of free places. These are—  
 1. *Stipendia*. Every province of Prussia can give a stipend of 200 thalers to a pupil who excels at the Provincial Trade School. 2. *Free places*. Besides the stipendiaries, each province can send up a pupil to whom the fees are remitted. The same privilege is given to the directors of various scholastic establishments. In exceptional cases, the State government does the same. Stipendiaries and those who fill the free places are obliged to take all the courses in their department, and to attend the repetitions. If they do not succeed well in the repetitions, they are liable to lose their subsidies.

The professors are paid at the rate of a hundred thalers annually for every hour spent weekly. Most of them eke out their incomes by teaching in other establishments, as the resulting salaries are only from 1,200 to 1,600 thalers a year. The whole annual expenses of the school are as follows :

Salaries of director and teachers,	-	-	-	-	-	-	22,000 thalers.
Collections,	-	-	-	-	-	-	1,500 "
Three chemical laboratories,	-	-	-	-	-	-	3,000 "
Machine shops, superintendent's salary,	-	-	-	-	-	-	7,000 "
Machine shops, materials,	-	-	-	-	-	-	2,000 "
Library,	-	-	-	-	-	-	1,500 "
<i>Stipendia</i> , aid, excursions, &c.,	-	-	-	-	-	-	7,000 "
Heating, lights, maintaining of repairs,	-	-	-	-	-	-	4,000 "
Administration, servants,	-	-	-	-	-	-	2,000 "
Total,	-	-	-	-	-	-	50,000 thalers.

#### INDUSTRIAL DRAWING SCHOOL.

The Industrial Drawing School (*Muster Zeichnen Schule*), trains designers of patterns for printing silk, woollen and cotton tissues, and paper hangings, together with all the theoretical and practical branches of weaving. It has its own director. The candidate must be fourteen, and be acquainted with rudimentary drawing.

The course, covering two years, is as follows: *First year*.—Drawing from models in relief, 24 hours a week; applied physics and chemistry, 4 hours; industrial drawing, 4 hours. *Second year*.—Composition and execution of designs for prints and figured tissues, 36 hours; preparing looms for quiltings, velvets, and practice in weaving, 16 hours; decomposition of tissues, and preparing the cards for weaving them.

Instruction is also given in drawing patterns for paper hangings, for oil cloths, silk, cotton, woollen, or linen prints, figured stuffs and ribbons, upholstery, fabrics, carpets, embroidery, and lace. The course of industrial drawing commences with the copying of flowers from nature; then from select drawings, and no pains are spared to accustom the pupils to the composition of new patterns. Drawing, is, in all cases, commenced from models or from nature, not from prints.

During the vacation of each year there is an exhibition of the pupil's drawings. Part of the drawings executed by the pupils remain in the establishment.

Certificates are given stating the extent of the instruction of each pupil.

The school fee is 12 thalers per half-year.



## ROYAL ACADEMY OF ARCHITECTURE AT BERLIN.

The Academy of Architecture at Berlin (*Bau Akademie*), has for its aim to train public and private architects, and civil and assistant engineers. The teaching staff of the institution numbers twenty-nine, five being titular and six assistant professors.

The course of instruction pursued at the Academy is divided into two sections, the first designed for assistant supervising architects (*Bauführer*), the second for architects proper and engineers in the Government service.

For admission to the first section, the candidate is required to bring a certificate of having been in the highest class of a gymnasium, or of having finished the course of a real school of the highest class; he must also prove, by certificate, that he has been practically employed for at least one year by an examined architect, and must produce several drawings executed under his supervision. A knowledge of leveling and measuring is also required. After passing this examination, he is matriculated, and is entitled to admission to all the lectures delivered in connection with the course, at the schools, the University, or the polytechnic, and to the various collections and the exhibitions at the Academy of Arts.

The instruction is given by means of lectures, and the following are attended by those desirous of obtaining the title of *Bauführer*. There are two semesters in each year.

*First Semester.* Solid, analytical, and descriptive geometry, with the application of the latter to constructions; spherical trigonometry; analysis, including differential calculus and conic sections. Physics, particularly as applied to light, heat, electricity, and magnetism. Chemistry, the elements and compounds, particularly those having relation to building materials. Architecture, construction, beauty and symmetry of form and practical usefulness, ancient architecture, its character and applicability to modern needs. Outline and ornament drawing.

*Second Semester.* Integral calculus and its applications. Scientific and practical study of perspective and shadows. Mineralogy and geognosy. Systematic study of building materials and their cost. Architecture; constructions; ancient architecture. Drawing; architectural and ornamental, with landscapes in pencil or sepia.

*Third Semester.* Dynamics; on statics of solid bodies and strength of materials. Machinery and mechanical action, such machines as are used in architecture being specially considered. Architecture; ancient, agricultural, with various industrial agricultural establishments; hydraulic architecture and bridge construction. Drawing; projecting and draughting of buildings; elaborate drawings from ancient architecture.

*Fourth Semester.* Dynamics as applied to architecture; mechanics, hydrostatics, acrostatics, and pneumatics. Surveying and leveling, with practical exercises. Building materials; their cost, source, and the means of obtaining them; their artificial manufacture. Architecture, hydraulic, bridges and roads; mills. Projecting and draughting of buildings. Estimates; superintendence; laws of the country regarding buildings and their construction.

Besides the above there are certain architectural designs to be drawn up and handed in at stated periods. These are the following: Four architectural drawings; one illustrating the laws of projection; one of perspective; four studies in ancient architecture; four elaborate drawings of ornament; two of engines and

their parts ; two projects of simple buildings ; two of agricultural establishments. After the examination, the title of *Bauführer* is conferred ; the candidate chooses the district where he will practice his art, reports there and is sworn in. He is obliged to send in an annual report of his occupations, and must be ready to respond to any call from government if he should desire to be admitted to the examination as government architect. If he intends to enter the government service as architect or engineer, he returns to the school after two years of professional labor. The lectures now pursued are different for architects and engineers.

**FOR ARCHITECTS.** *First Semester.*—Ancient architecture. Italian architecture during its highest development. Projecting and drawing of architectural subjects, especially of the first class and public buildings. Ornament.

*Second Semester.*—Technology. Principles of construction as applied to extensive buildings and cases presenting special difficulty. Internal arrangement and exterior style of dwellings and edifices of art. Public buildings, their projection. Drawing and projecting. Gothic ornament, with drawings and lectures.

**FOR ENGINEERS.**—*First Semester.* Computation of probabilities applied to the theory of the reliability of observations and experiments. Mechanics, and engine construction. Sketching and computations regarding construction and power of engines. Hydraulic architecture. Railroads and all matters connected with them.

*Second Semester.* Analytical dynamics, and all its applications in architecture and engineering. Geodesy, with practical exercises. Draughts of engines. Projection, draughting, and computation of cost of hydraulic works. Railroads ; construction of stations, depots, and “running stock.” Architectural technology. Telegraphy.

Modeling, foreign languages, &c., are taught, but form no part of the examinations for government situations. The examinations are open also to persons who have not pursued the course at the school. Candidates for the title of private architect must be a master in one of the three trades of mason, carpenter, or stone-cutter. Assistant engineers are not examined, their attendance in the past is examined and they are then sworn in. There are no prizes, but the one successful in an annual and optional competition, receives a donation of about 2,000 francs for traveling abroad.

The fees are as follows :—One at matriculation, of 10 thalers, and lecture fees of about 18 thalers, annually. The titular professors receive 2 thalers for the hour's lesson, the others, 1½ thalers, and the assistants, 1. The school fees amount (1865), to 11,500 thalers ; the expenses were 25,975 thalers. Half of the excess was furnished by the Government, the other half came from various sources.

In the same year there were 472 pupils ; 314 being entered for the service of the State, 34 as private architects, 55 as foreigners, and 69 as free auditors.

#### BUILDING SCHOOL AT BERLIN.

The Building School, (*Baugewerbe Schule*), at Berlin, gives theoretical instruction to all classes of building artisans, as carpenters, masons, roofers, potters, &c.

The course includes German, arithmetic, algebra, geometry, physics, elements of force and heat, lessons in proportions, construction of buildings, fundamental doctrine of projection, agricultural buildings, architectural and free-hand drawing, and modeling in clay. Fourteen thalers are paid for the whole course ; for the winter course alone, five.



## SUPERIOR WEAVING SCHOOL AT ELBERFELD.

The Superior Weaving School at Elberfeld, a town owing its rapid growth principally to this branch of industry, has for its object to impart theoretical and practical instruction in the various departments of the art, and also includes a department of general technical drawing. It is open to pupils of all countries.

The course is divided into three divisions, and the pupil can attend them all if he pleases. These are—(1) weaving; (2) pattern drawing; (3) the chemical processes of weaving and dyeing.

*Division I.* The first division teaches the whole art of weaving, theoretical and practical, the instruction being carried so far that the pupil can undertake the independent management of a manufactory or of an establishment trading in these fabrics. It occupies 36 hours a week for a year and a half, the course commencing twice a year, and consisting of two parts, the analytical lasting twelve months, and the composition course lasting six. By analysis (*decomposition*) is understood the elements of weaving, a knowledge of the machines and materials used; analysis of the modes of making patterns in plain fabrics, practical exercises in the various operations of weaving, the elements of Jacquard weaving, analysis of and mode of setting patterns for these fabrics, practical exercises with the Jacquard looms, free-hand drawing, painting and modeling from nature. The second part, for composition, can be entered upon only by those who possess the knowledge imparted in the preceding. It comprises further instruction in materials, their prices, and in all processes connected with the weaving of linen, cotton, woolen, and silk; the choice and calculation of the quantity of yarn to be used for various materials with reference to the changes caused by dyeing, and the loss sustained in weaving; knowledge of the composition of all kinds of textile fabrics from the simplest to the most complicated, and of all the technical and artistic processes connected with their production; calculation of the special items, and of the entire cost of the fabrics; and practical exercises in all the details of the preparation of weaving with all the different kinds of looms, and in the composition of designs, patterns, &c.

The pupils of this division may attend the lectures on chemistry and physics in the chemical department without adding to their term-fees. The practical exercises in the workshops are held from 8 to 12 A. M., and from 2 to 7 P. M. The fee for the entire division is 120 thalers, the second part alone costing 90.

*Division II.* The second division teaches the art of drawing and inventing designs and patterns for all woven and printed goods, and pattern-card makers who are able to arrange every pattern correctly on the cards. There is also instruction in general technical drawing. The method adopted is that of Dupuis, in which the pupil begins with drawing from nature or from the model in relief.

The course is divided into two sections, beginning twice a year, and occupies twenty-four hours a week. Lessons are given in free-hand drawing, and painting, first from models, afterwards from natural objects, such as plants, flowers, vases, &c.; knowledge of the colors used in manufactures, and the mode of applying them; composition of patterns, and knowledge of and practical exercise in pattern-making from textile fabrics, drawing, &c. The annual fee is 30 thalers. There is a special morning and evening class for scholars who cannot attend the regular course, held eight hours a week, at two-thirds of a thaler the month.

*Division III.* The third division imparts thorough theoretical and practical instruction in technical chemistry to dyers, printers, manufacturers of colors and



chemicals, &c., and also to those who wish to qualify themselves to become technical teachers. There are two courses, the first being for practical chemists in general, the second for dyers, printers, bleachers, color manufacturers, and manufacturers of chemicals specially. Each lasts a year, with a summer and winter course, and no one can enter the second without being prepared in the first.

The instruction given in the first course is as follows :

1. *Inorganic chemistry*. A full course. Connexion between chemistry and the other branches of natural science. The objects to be accomplished by chemistry ; its progressive development. Stoichiometry. The lectures are illustrated by the use of a large collection of specimens, and by constant experiments ; 4 hours weekly. 2. *Knowledge of chemical substances (Droguen)*. Inorganic chemicals. Particular inorganic substances (as sulphurous acid, soda, chlorine, &c.,) of especial importance to technical chemists are selected and thoroughly discussed. Visits to manufactories, examination of the chemicals belonging to the school and practical exercises further complete the lessons. 3. *Analysis*. Qualitative and quantitative analysis, extended to all substances important to technical chemists, the course of qualitative analysis being general, that of quantitative adapted to the future calling of each pupil. Particular attention given to trituration (*trituren*), 2 hours. 4. *Physics* applied to industry, 2 hours.

In the second course are taught : 1. *Dyes and colors*.—Special lectures on coloring stuffs, with practical exercises. The collection is studied 6 hours. 2. *Analysis*.—General analysis continued ; special analysis of dye stuffs, 2 hours. 3. *Physics* continued, 2 hours. 4. *Theory of dyeing*.—Chemical and physical consideration of raw materials (cotton, linen, wool, and silks) ; analysis of simple mixed stuffs ; preparation of the yarns for dyeing (bleaching of cotton and linen yarn, removing the greasiness of woollen textures, scouring silk) ; influence of the reactionary agents (air, light, heat) ; relation of vegetable and animal fibres to dyeing stuffs ; substantive colors ; abjective colors ; theory of tanning ; tanning stuffs ; choice of dressing for printed goods ; its influence on the shades of colors, &c. Glazing (chemical and mechanical arrangements). All the lectures are elucidated by experiments, and, indeed, one of the chief objects held in view, is that the pupils have practice in dyeing and coloring all kinds of yarns and textures, 6 hours. 5. *Analysis of colored stuffs*, 2 hours.

Only dyers, printers, &c., need to go through both courses. For other technical pursuits, the first is enough. The fee for the lectures is 20 thalers per half-year ; for participation in the laboratory practice, 40 thalers additional. There is no extra charge for gas or other materials.

Each pupil in the school keeps a book in which are collected the patterns of the different kinds of tissues which he has to analyze and decompose, calculating their elements, and reproducing the perforations of the cards by sketches. He prepares a pattern, arranges cards, and then makes ready the loom, and sets to work. The school provides materials, but little work, however, is done.

There are 78 pupils ; 45 in the first division, 25 in the second, and 8 in the third. The building was built by the town, the looms and other furniture provided by the State. It possesses 42 looms, and a large collection of every kind of machinery and other implements connected with weaving ; of specimens of ancient and modern tissues, home and foreign ; drawings, engravings, models, compositions, &c., for the use of the scholars. There are well arranged laboratories, with room for twenty or thirty pupils, for special technical analysis.

The annual expenditure is about 10,000 thalers, and the excess of the expenditures over the receipts is paid half by the town and half by the government.



## INSTRUCTION IN AGRICULTURE AND RURAL ECONOMY.

To a Prussian citizen is due the credit of having established the first scientific agricultural school in Prussia. This was the institution at Möglin, founded in 1806 by the celebrated Thaër.\* The first step taken in this matter by the Prussian government was in 1819, when the school of Möglin was made a royal institution.

The agricultural schools of Prussia are divided into primary, intermediate, and superior. In the superior schools the course is very full and includes many high theoretical studies; in the intermediate class the pupils are prepared for the higher, and receive an exclusively practical instruction, except during the winter; in the inferior class the pupils take the place of hired servants, pay little or nothing, or are paid for their services. They are occupied in manual labor or in tending horses and cattle.

There are thirty-two of these schools in Prussia. Five are superior: Möglin, Eldena, Proskau, Regenwalde, and Poppelsdorf. The whole number of professors in these is thirty-three. Eldena is the best attended. Two are in connection with universities: Eldena with Greifswald, and Poppelsdorf with Bonn.

There are two intermediate schools and twelve of the inferior class.

There are thirteen special schools connected with agriculture, of which we will mention the following: two of meadow culture, one for shepherds, eight for the raising, dressing, and working of flax, and one, at Potsdam, of gardening. At Berlin there is a veterinary school. The two of meadow culture are at Kramenz, in Pomerania, and at Janowitz, near Heyerswerda. There is a forestry school at Neustadt Eberswald.

Instruction in pomology, or the cultivation of fruit-trees, is given in the normal and primary schools to an immense number of children.

As an accessory to the system of agricultural education, may be noticed the large collection of farming tools and specimens of forest, farm and industrial productions at Berlin and Breslau.

All of these establishments are under the supervision of the Minister of Agriculture.

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\* *Albrecht Daniel Thaër* was born at Celle, in Hanover, May 14th, 1752. He studied medicine at the University of Göttingen, and took a degree in that profession, and was very successful in its practice. During his leisure, he occupied himself with cultivating flowers, and in this way gardening and agricultural pursuits became a passion with him, and he withdrew from the profession. He died October 26th, 1828. He published the following books on agriculture:

1798. *English Agriculture, with a view to the improvement of German.*

1799. *Annals of Lower Saxon Agriculture.*

1800. *Cattle-Breeding—Additions to Bergen's work.*

1803. *Agricultural Implements.*

1804. *Bell's Agricultural Essays, translated, with rhapsodical additions.*

1805. *Annals of Agriculture.*

1810. *Principles of Rational Agriculture.*

1811. *Annals of Agriculture at Möglin from 1817 to 1823.*

1811. *On Fine-wooled Sheep.*

1813. *Attempt to ascertain the Net Produce of Farms.*

1815. *General System of Agricultural Knowledge.*

1815. *My Farming, (at Möglin.)*

1815. *Circular to obtain the Net Produce, as a Basis for Correct Taxation of the Land.*

1815. *Wool and Sheep-breeding.*

## ROYAL AGRICULTURAL SCHOOL AT ANNABERG.

The Royal Agricultural School at Annaberg, which we select as an example of the intermediate class, has for its object to train peasant farmers and bailiffs. It admits none but sons of small farmers, about twenty-five years of age, provided with a certificate of baptism, of having attended school, of good mental capacity and conduct, and of the place to which they belong.

The course of instruction lasts one year, and pupils are not allowed to quit before the close, or remain beyond the time. The plan is to make the pupils acquainted with all the branches of a well-organized farming business, and more particularly to explain the necessary connection of its several branches and the reasons why every thing is done.

The theoretical instruction is, in summer, confined to explanations in connection with the farm work performed. In winter, several hours daily are devoted to drawing up simple reports, agreements, receipts, &c., the leading principles of natural science, of special sciences applied to agriculture, and veterinary medicine. Popular hand-books are used as text-books, and the rich collections and apparatus of the Academy of Poppelsdorf.

The practical instruction is pursued according to a fixed plan for gradually perfecting the pupils in all the varied work of a farm. They alternate therefore in feeding and tending cattle, in using manures, in cultivating and gathering crops, and the processes following the harvest, in draining, and in meadow work.

The school farm is the royal domain of Annaberg, and is conducted on the plan of securing a high and permanent profit. It includes a large orchard, nursery, and vegetable garden, besides meadows, and waste lands which are being gradually redeemed. The character of its soil is very varied, affording opportunities for many different kinds of culture.

The number of scholars is temporarily fixed at six, and board at \$69 a year.

## AGRICULTURAL SCHOOL AT MOGLIN.

The Royal Institute of Agriculture at Möglin was founded by Thaër in 1806, and kept in existence through those troubled times only by the great talents of the founder. In 1819, the Prussian government, following the example of Würtemberg, constituted it a royal institute and assimilated its professors to those of a gymnasium, both as to rank and salary, with the condition that certain pupils, sent from Berlin, should receive gratuitous instruction.

It is a boarding-school, and is governed by a director. The course lasts four years, beginning October 1st and closing on the 1st of August. The instruction includes lessons in mathematics and the physical and natural sciences as applied to agriculture, rural economy, veterinary art, and forestry. It gives more special instruction in farm accounts, raising fine wool, meadow irrigation, and potato cultivation on a large scale. The price of board and instruction is, for the whole course, \$240. Pupils are admitted temporarily at \$7,00 per week.

The domain, which is yet in the hands of the Thaër family, consists of 1,050 acres of poor, sandy land, 50 of natural meadows, and a wide extent of pine forest. There is a vast stock of sheep, cows and bulls, horses and swine. In all, at the time of the visit of M. Royer in 1844, there were 1,850 animals, among which were 1,600 sheep, 60 cows and oxen, and 12 horses, with 21 farm laborers. The principal industry was distilling potato spirit and raising wool. It admits 20 pupils; 511 have been through the four years' course.



## ROYAL AGRICULTURAL ACADEMY AT POPPELSDORF.

The object of this academy is: 1. To afford an opportunity to young farmers who have a certain amount of preliminary, scientific, and general knowledge, and who are skilled in handling the implements of their calling, to make themselves acquainted with the sciences specially applicable to agriculture, as also the auxiliary sciences, in as far as is required for the rational farming and administration of a landed estate in the present day; and, 2. To offer to students of jurisprudence and of political science, as well as to all others whose future vocation may render some acquaintance with the rational mode of conducting an agricultural business useful (though they may not intend to become practical farmers,) the means of learning to know the theoretical as well as the practical principles of such a business, and to acquire a distinct notion of its organization and the mode of conducting it.

The aim of the academy is thus not only to educate men to be thoroughly capable of conducting the business of larger or smaller estates, whether as proprietors, farmers, or land-stewards, but also to enable future officials in the administrative departments of government, who may require more than a superficial knowledge of rural economy, to obtain this.

The studies in the academy are distributed as follows:

## I. BRANCHES OF STUDY CONNECTED WITH FARMING.

A. AGRICULTURE.—1. *Knowledge of the soil:*

Upper stratum of the earth. Atmospheric action of constituents of the earth. The influence of mountain formations on the composition and fertility of the soil. Physical properties of the soil. The classification of soils. The distribution of soils. Sub-soil and surface soil.

2. *Study of manures:*

Principles governing the nourishment of plants. The difference between wild and cultivated plants. Stable manure. Combination of the different animal manures, with stable litter. Treatment of manure in the stable, the yard, and the field. Liquid manure, litter, nightsoil, other animal, vegetable, and mineral manures. Economic importance and use of the same. Different processes for preparing manures for sale, and different methods of applying them.

3. *Clearing, draining, and working the land.*

The most important process of tillage; different modes of culture required for woods, heaths, moors, and sandy places.

Evils of dampness. Different methods of draining, more particularly by underground drains. Draining combined with practical demonstrations; cost and results.

Various objects and various methods of tillage, deep soil culture, fallows. Different methods of cropping, change of crops. Rules to be followed in sowing, reaping, and storing produce.

4. *The knowledge of agricultural implements and machines.*

The importance of agricultural implements and machines. Materials used in their construction.

Implements for working the ground; hand tools; horse machines; the plough. The importance and history of the plough; what is expected from it. The work of the plough. Theory of the plough. Its different parts. Classification of ploughs. Judgment of the different kinds of ploughs with reference to the uses they are to be put to. The extirpator, the scarifier, horse chopper, drag, roller.

Sowing machine system; machines for broadcast, drill and dibble sowing. Criticism of the methods most in use. Machines for spreading manure. Machines for pulverizing manure. Machines for liquid manure.

Various reaping machines, machines for mowing corn, grass mowing machine, horse rakes, haymaking machines, potato-digging machines.

System of threshing by machinery; hand winch, and steam threshing machines.

Criticism of the most important

Machines for cleaning grain (cleansing and sorting machines.)

Groat, flour, and crushing mills, and oil-cake crushers.

Chopping machines and root-cutters.

Other machines and implements, pumps and hydraulic engines. Machines for making drainage pipes. Winchwork. Implements of transport, (carts, wagons, sledges.)

5. *The cultivation of grain and fodder:*

The special culture required for each plant; requirements as to climate and soil.

Succession of crops; preparation and manuring of fields; arrangement; care during vegetation, harvesting, storing, and transport.

6. *The cultivation of materials for manufacture:*

The special culture of each plant as in No. 5.

The lectures on the cultivation of special plants will be elucidated by practical demonstrations on the farms of Poppelsdorf and Annaberg.

7. *The cultivation of grass lands:*

Examination of the different modes of culture, distribution of meadow land.

The forming of meadows by sowing.

The treatment of meadows which can not be irrigated. Clearing, leveling, manuring, breaking up or draining; forming of water meadows, advantages of irrigation, implements used in the cultivation of meadows, trenching; other operations connected with the artificial treatment of meadows, flooding, aqueducts, special methods of irrigation, overflowing, the Peterson system, making valuations, the care and keeping up of artificial meadows.

8. *The cultivation of vines and vegetables:*

(a) The cultivation of grape-vines; on the nature of the grape. The places in which it is indigenous; the climatic requirements; the propagation and improvement of vines; making and working vineyards; different methods of production; treatment and cultivation; quantity and quality produced; the diseases of grape-vines.

(b) The importance of the cultivation of vegetables, where there are accessible markets. The laying out of the vegetable garden. The cultivation of vegetables on sound principles, with special reference to the kinds of vegetables suited for country populations, and for sale in large quantities.

9. *The cultivation of fruit trees:*

Principal facts in the history of fruit culture. Knowledge of fruit culture, with demonstrations. The choice of the best and most useful varieties. Their requirements as to climate, situation, and soil. The raising of fruit trees, with demonstrations. The laying out and management of nurseries for fruit trees. The planting, division, and management of the improving orchards. Improvement of the quality of fruit trees. The theory and modes of proceeding as to different methods of grafting, with practice. Rearing, cutting, and shaping the grafted tree. Fruit tree plantations, mode of planting and tending them. The diseases of fruit trees. The use and storing of different fruits. The profits derived from fruit culture.

B. CATTLE-BREEDING.—1. *The general rearing of animals:*

Relations of cattle-breeding to agriculture. Importance of this at the present time. The fundamental principles of cattle-breeding, &c. The art of breeding; the origin of races; artificial and natural races. Technical expressions; breeding; descent; influence of both sexes on the breed. Influence of parentage; individual influence, cross breeds, thorough breeds. The school of Buffon. Breeding in and in. Different methods of crossing. Darwin "On the Origin of Species." Instruction as to feeding. Different kinds of food and their constituent parts. Effects of different kinds of food. The natural inclinations of domestic animals with respect to different kinds of food. The volume of food. The amount of water contained in the fodder. The relation of protein to hydro-carbon. The effects of fat. Preparation of food. Salt as an ingredient



of diet. Mixed foddors. Rules for determining the amount of nourishment in different kinds of food. Of the individual kinds of fodder. Matters to be taken into consideration in determining the quantity of food. Mode of estimating quantities to be given for substance, for fattening, and for diminishing fat.

The further care of domestic animals. The allotment of food for stated meal-times. Change of food. Drinks. Temperature of the stables. Air, light, exercise, treatment in other respects.

2. *The breeding of horned cattle:*

Importance of breeding horned cattle. Points in natural history. Breeds of oxen, the English breed in particular.

Breeding, choice of breed, method of breeding, choice of individuals for breeding. The relation between bodily form and usefulness in various respects. Rearing of calves.

Feeding and tending full-grown cattle:

General principles on which cattle should be fed. Amount of food required. Summer stall-feeding. Pasturing, a mixture of the two. Winter food. Alternation of fodder. The stable arrangements. Persons tending the cattle.

Employment of cattle on a farm:

The dairy. Chemical and other properties of milk. Testing milk. Matters that influence the quantity and quality of milk. The making of butter and cheese. *Fattening*—Choice of stock for fattening. The process of fattening calves. The meat market. Classification of meat. The purchase of fat beasts. The use of oxen for labor. Choice as to breeding or purchasing.

3. *Horse-breeding and knowledge of the external parts of horses:*

Horse-breeding.—Its importance. Natural history. Principal races of horses. Choice for the various purposes of breeding. Pairing. Keeping and tending stallions and mares. Tending of and feeding foals. The most important diseases incident to foals. A knowledge of the external parts of horses. Bodily structure of the horse. The relation of one part to the other. Differences of form and development with reference to the various services for which the horses are destined. Paces. Age of teething. Precautions to be observed in purchasing horses. Practical demonstrations.

4. *Rearing sheep and the knowledge of wools:*

(a.) Sheep-breeding; importance of breed. Natural history. Breeds of sheep. The history of merinos. Breeding, right method of breeding. Choice of direction of breeding. Process of breeding. Choice of stock for breeding. Register of breedings. Pairing. Lambing. Keeping of lambs and ewes.

The nourishing and tending of the full-grown animals. General principles as to the nourishment of sheep. Amount of food required. Stall-feeding. The two methods combined. Winter fodder. The preparation of food. The choice of food. Persons attending the sheep. Arrangement of the folds. Utensils for holding food.

Treatment and sale of produce. The uses of wool. Washing. Shearing. The sale of wool. Use of the milk. Separating the sound animal from the unsound. The sale of fatted beasts. Sale of sheep for breeding.

The use of sheep on the farm. Principles of different modes of sheep farming. Composition of flocks. Calculation of the cost and profit of different modes of sheep farming.

5. *The knowledge of wool:*

Of wool in general. Technical preparation. Cloth wool and carding wool.

Special properties of wool. Fineness, curl, softness, strength of fibre, elasticity, length, color, gloss, oiliness.

Wool in staple and fleece; quality of staple. Thickness of the wool; outward form of the staple. Inward construction of the staple. Shortness, evenness. Matters to be observed in judging of the yield of the wool.

6. *Rearing of smaller animals:*

(a.) Rearing pigs. Importance of rearing pigs. Natural history. Breeds.

Breeding. Selection of breeds. Process of breeding. Choice of individuals for breeding. Register of breeds. Birth. Care of the litter.

The feeding of pigs. General principles of feeding. Amount of food required. Alternation of food. Gradual process of fattening. Sale of the fatted animals.

(b.) The rearing of domestic poultry. Knowledge of races, breeding, feeding, and tending. Different plans of management.

*Sanitary matters connected with the treatment of domestic animals.*—General external influences which affect the bodily condition and health of animals, and the amount and quality of the animal; product more particularly.

(a.) Atmospheric influences affecting respiration, the developing heat, and the functions of the skin. Heat and cold, moisture, crowding, exercise, light, &c.

(b.) Food and drink. General character of these. Their relations to the organs of digestion, and the different purposes of feeding. Amount of food to be given. Preparation of food, &c.

(c.) Tending and care, housing.

C. THEORY OF FARMING.—1. *Principles of political economy involved in rural economy:*

Object of rural economy: land and soil, and their adaptability for different modes of culture. Position of the different classes of agricultural laborers. Work done by horses. Choice of cattle for draft. Number of laborers required. Application of machinery. Capital, its distribution. Productivity of the capital invested in the various branches. Relative proportion of these sums to each other, to the land worked. Sale of products. Character, size, and distance of the market-town. Influence of trade relations on the entire business of the farm. *The Farmer*—His education. Administration of the estate by the proprietor. Letting to a farmer. Conduct of large and small farms. The relation of industry to agriculture. Agricultural associations and means for taking credit.

2. *Farming systems:*

The management of large estates, and the preparation for carrying out plans for working.

Nature of objects aimed at in the management of an estate. Different systems of farming and different rules of rotation. Critical examination of the same. The conditions on which they can be profitably carried on. Parceling out of fields. Diffusion of the established systems and alterations introduced by progressive civilization. Change to a new system and new rotations. Choice of collateral branches of business in connection with the farm. Conduct of the business. Persons engaged in the management. Their duties and position. Choice and acquisition of estate by purchase or on lease. Agreements for purchasing and taking leases. Founding new estates. Instructions for laying out a farm.

3. *Valuation of land and instruction in making estimates of productions:*

Meaning and object of valuation. Different reasons for valuation.

Principles of valuation. Improvements. Different methods of classification. Estimate of gross revenue derived from the various branches, and from the entire outlay on the estate. Estimate of net profits. Estimate of the capital value. Special and general valuation. Practical instructions for making estimates of revenue.

4. *Agricultural book-keeping:*

As a guide to the lectures, treating of the importance, the principles, and the method of the improved system of keeping agricultural accounts, the director, Dr. Harstein's work on the subject shall be used, and for practical exercise the pupils shall make out a year's accounts of the Poppelsdorf estate, according to the system of double entry.

5. *Agricultural calculations:*

These lectures, which are illustrated by examples, treat of the solution of manifold questions connected with the administration of landed property by means of arithmetical formulas. For instance, calculation of the cost of production of, and of profits which ought to be realized on, various agricultural products; proofs of the advantages of various operations, such as the use of particular machines, of new methods of cultivation, of the technical manipulation of products, &c.

D. HISTORY OF AGRICULTURE.—1. *History and statistics of agriculture:*

History of the gradual development of agriculture, especially in Germany. Sketch of the present state of agriculture as shown by official statistics. The



condition of Germany will hold a prominent place with regard to this branch of the subject also.

2. *Literature of agriculture, with special mention of the newest publications:*

The gradual development of agricultural literature, as shown by the leading ancient works on the subject. Critical examination of the most important modern works on agricultural subjects.

3. *Comparative statement of the condition of agriculture in the principal European countries, with particular reference to England and Germany:*

Comparative account as above, taking into account the natural conditions of the various countries, their means of communication, &c., with a view to affording German agriculturists a clear understanding of their own position in relation to those of other countries, and of the advantages and deficiencies of German agriculture.

II. FOREST ECONOMY.—1. *Forest culture:*

The importance of forest culture. Cursory view of forest botany. The artificial and natural first growths and after growths of the useful forest products, with practical demonstrations.

2. *Forest industry, the protection of forests, and valuation:*

A knowledge of the quality and proper use of different woods. The ingathering and improvement of forest products (forest technology.) The transport and valuation of the useful produce of the woods. Measures of protection with regard to the damage done to woods by men, hurtful beasts, and bad weather. Accounts of the produce of woods, and calculation of the net profit thence accruing from them, and of the consequent capital value of the woods. In these lectures, particular notice will be taken of private woodlands, and the most important subjects relating to such will be treated in detail.

3. *Concerning hunting and fishing:*

Division of subjects. History. Breeding of game. Preservation of game. Hunting, and proceeds of hunting. Formation, maintenance, and management of fish-ponds.

III. NATURAL PHILOSOPHY.—1. *Inorganic experimental chemistry:*

Introduction. Properties of simple bodies. Laws of chemical combinations and decomposition. Description and conditions of compound inorganic substances. The whole department of inorganic chemistry will be discussed in these lectures, and illustrated by experiments, a deeper study being devoted more especially to those elements and their combinations, which are of special importance in the economy of nature, and which play a prominent part in agriculture.

2. *Organic experimental chemistry.*

Introduction. Special character of organic combination. Substances of immediate and mediate organic origin, among the first, hydro-carbon, vegetable acids, fatty substances, substances containing nitrogen, &c.; among the second, alcohols, ethers, the products of dry distillation, &c. The extent of the instruction given on these subjects will be in proportion to their importance with regard to the vital processes of plants and animals. The lectures will be illustrated by experiments.

3. *Analytical chemistry, with practical exercises in the laboratory:*

Introductory lectures on analytical chemistry. The students receive, first, instruction in qualitative examination of minerals, vegetable ashes, soils, manures, &c.; and afterwards in quantitative analysis, for which the chemical laboratory has every requisite. Participation in practical work will only be allowed to those who have gone through previous study of inorganic chemistry.

4. *Chemistry of soils:*

General survey of the process of chemical decomposition of arable soils, both with respect to its mineral and its organic constituents. The chemical theory of the exhaustion of soils, and of manures. These lessons are completed by lectures on the practical knowledge of soils.

5. *Animal chemistry:*

Chemical principles of the process of animal nutrition, and of change of substances. A critical examination of the most important experiments in feeding characteristics of the animal substances most important in practical life.



6. *Literature of agricultural chemistry :*

History of agricultural chemistry. A survey and criticism of the most important works of ancient as well as modern literature bearing upon this science. A detailed repetition of selected chapters on the subject of theoretical chemistry.

7. *Experimental physics :*

(a.) Statics and dynamics. Introductory lecture. General properties of matter. Laws governing the equilibrium and motion of solids, liquid, and aeriform bodies. The phenomena of diffusion and endosmose.

(b.) Science of heat and meteorology. On conducted and radiated heat. The most important effects of heat. Expansion of bodies, alterations of the state of aggregation. Elasticity of steam. Detailed descriptions and illustrations of the steam-engine. Influence of heat on climatic changes. Origin and metamorphosis of the atmospheric precipitates (*Niederschläge*.)

(c.) Electricity, magnetism, sound and light. General physical theory of the laws governing the powers of nature. Explanation of their natural action, (Northern lights, tempests, their effects on vegetation, &c.,) and their applications in practical life. Telegraphy, photography, &c. The course of lectures on physics will be illustrated by experiments.

Each of these three sections of physics will form a connected whole, so that the study can begin with either without much loss. Besides the first section on statics and dynamics will be taught in the lectures given during one half-year of the second year's course on agricultural machinery and mechanics.

8. *Mineralogy and geology :*

A brief sketch of geology.

Composition of the crust of the earth. Rock formations, their structure, position, and origin. Mountain formations, upheavings and sinking. Volcanic phenomena. The geological action of water, (springs, erosion, and deposits caused by rivers, seas, and lakes.) Characteristics of the most important sedimentary formations. Coal, peat, salt deposits, &c. History of the inorganic world. The characteristics of minerals which constitute the chief ingredients of rocks, and the products of the decomposition of which form the soil. Minerals most important to miners and for technical purposes.

9. *Botany in general and the anatomy of plants :*

*Morphology.* The outward form and anatomical characteristics of the organs of plants.

*Principles of systemization.* Characteristics of the classes, orders, and most important families of the vegetable kingdom, their habitual, anatomical, and morphological distinctions. Reference to the general principles of natural systematization.

*The most important facts touching the geography of plants ;* limits within which plants are distributed over the earth; their natural habitation and their emigrations.

*Paleontology of plants.* Characteristics of the vegetation of various geological epochs.

10. *Physiology of plants :*

Detailed representation of the structure and functions of the organs of plants and of outward influences on vegetation, (for instance, of nourishment taken in through roots and leaves, assimilation and course of the sap, transportation, the influence of light, of warmth, of air, of the soil, &c., on the vital process of plants, &c.)

11. *Agricultural botany and the diseases of plants :*

Monographic descriptions of all the agricultural plants and meadow grasses in Germany, their habits, germination, vegetation, and fructification. Reference to the relations of their physiological conditions, to their cultivation, country, history, and distribution of the several kinds of plants suited for cultivation. The lectures will be illustrated by demonstration on living plants, in the lecture-room and during excursions.

In the description of agricultural plants, their diseases, and what is noxious to them, will be touched upon; afterwards a general survey of the diseases of plants, and more especially of those caused by parasites, will be given.

12. *Selected sections of general botany and vegetable anatomy and physiology :*

The most important matters comprised in these departments will be specially



dwelt upon, and the newest publications on these subjects will be mentioned, so as to enable the student to continue his studies in this direction.

13. *Practical exercise in using the microscope, and experiments as to the physiology of plants:*

(a.) *Use of the Microscope.* Introduction to the use of the microscope. Exhibition and preservation of microscopic preparations, and practice in microscopic investigations; (b.) Introduction to experiments on plants. The student will have the opportunity of personally testing the most important questions in the physiology of plants. For example, the examination of transpiration, nourishment, the influence of light, of warmth, &c. Only those students who have heard the necessary preparatory lectures can take part in these microscopic and physiological experiments.

14. *Anatomical and physiological survey of the animal kingdom:*

The most important points bearing on the organization of the classes and orders of the animal kingdom. The influence of external and internal structure on the habits of life. General remarks on the processes of nutrition, respiration, and circulation, the action of the nerves and muscles, functions of the organs of sense and propagation. These lectures will be illustrated by numerous demonstrations.

15. *Natural history of invertebrate animals:*

The chief part of these lectures will treat of the natural history of insects important to the agriculturist and to the manager of forests; and that of bees and silkworms will be fully elucidated by demonstration. The rest of the lower classes of animals will be briefly treated of, and their relation to man specially touched upon.

16. *Natural history of vertebrate animals:*

Characteristics of mammalia of birds; of amphibious animals and of fish. Their chief anatomical and physiological features, with particular reference to the species useful or hurtful to man. Anatomical demonstrations.

17. *Repetitions in natural philosophy:*

During these repetitions, students, and more particularly those who have been unable to follow and complete the two years' course of instruction, will have an opportunity of gaining an encyclopædic insight into all the various branches of natural philosophy taught separately in the academy.

IV. MATHEMATICS.—1. *Practical geometry and exercises in measuring land and leveling:*

Theorems in practical geometry; their use in the art of measuring fields. Application of the latter to agriculture. Practical exercise in measuring fields, (with measuring bars, cross discs, the surveyor's table, the compass, the theodolite,) and in leveling.

2. *Agricultural mechanics, and the study of machinery:*

Laws of motion; natural powers; estimation of their strength and working capacity; friction, solidity of bodies, mechanical powers, their application and combination as agricultural machinery.

Water pressure, motion of water, (in rivers, canals, and conduits.) Water power and water wheels.

Atmospheric pressure, and its practical application. Steam power and steam-engines. Mills.

V. POLITICAL ECONOMY.—1. *The principles of national economy:*

Fundamental idea of property. Systems of national political economy. The characteristics of national wealth. Laws governing the production, the distribution, and the consumption of goods.

2. *Political economy:*

Relation of the State to the national wealth. Way and means of governing in order to obtain the maximum of national prosperity.

Administrative measures and regulations relative to the production, distribution, and consumption of goods.

VI. JURISPRUDENCE.—1. *Introduction to the laws respecting agriculture:*

A short view of the existing works on land in Germany. Explanations of the idea connected with the terms, person, things, action, agreement, &c. Laws concerning property, law of inheritance, law of entail, &c.

The lectures on the general principles of law will hold constantly in view the relation of these to agricultural law, and the very extensive subject will thus be limited and determined.

2. *Agricultural law.*

3. *Agrarian legislation (Agral Gesetzgebung.)*

VII. VETERINARY SCIENCE.—1. *Anatomy and physiology of domestic animals :*

These anatomical and physiological lectures, which are to be considered as laying the foundation of the knowledge of veterinary science, of sanitary science, of the laws of health as regards animals, and of the breeding of animals, treat of these subjects in detail, and in connection with numerous demonstrations on living and dead animals.

2. *Acute and contagious disorders of domestic animals :*

This lecture treats of the most common internal diseases, and of all infectious and contagious complaints of animals, their classification according to the parts they affect, (diseases affecting the organs of respiration and digestion, &c.,) their causes and course. As the object is not to give profound veterinary knowledge, but rather to enable the farmer to recognize the first symptoms of illness, and so form a right judgment as to their danger, to treat slight illnesses himself, and, in urgent cases, when the veterinary surgeon can not be obtained quickly, to apply the proper medical and surgical treatment ; that part of therapeutics will be taught, more especially, which has reference to the treatment of slight and acute diseases.

3. *External diseases of domestic animals :*

Their division according to the seat of the disease in the various parts of the body. In respect of these diseases, also their appearance, their usual course, their local and general importance, and their tendency to become hereditary, &c., will be taught more in detail than the therapeutical and surgical treatment of them. As far as possible, practical demonstrations will be added to scientific teaching. Besides this, practical exercise will be afforded by the performance of special slight operations, such as bleeding, cauterizing, &c.

4. *Shoeing and tending.*

(a.) *Shoeing.*—A short sketch of the anatomy and physiology of the hoof. The horse-shoe. Shoeing sound hoofs. Shoeing diseased hoofs. Shoeing in abnormal positions and for irregular paces. Practical illustrations.

(b.) *Tending.*—All matters relating to the symptoms and treatment of female animals during bearing time.

VIII. TECHNOLOGY.—1. *General Technology :*

Introduction. Study of materials for burning and lighting. Preparation of fuel. The technical importance and application of water. The manufacture of animal and vegetable fats, of weaving and spinning fibres. Clay, gypsum, and lime-burning.

2. *Technology of collateral branches of rural economy :*

Importance, application, regulation, and management of allied industries, showing the most recent scientific and practical improvements ; for instance, in the manufacture of starch and sugar, brewing and distilling, the making of wine, the manufacture of vinegar, the preparation of bread, butter, and cheese.

Illustrations by experiments, drawings, models, and visits to manufactories.

IX. ARCHITECTURE.—1. *Building materials and the art of building :*

The knowledge of building materials, the mode of obtaining them, and rules for their selection. Descriptions of the most important building works, their valuation, and terms which ought to be paid for their construction.

2. *Construction and arrangement of agricultural and industrial buildings :*

These lectures will be illustrated by drawings and models, as well as by buildings already erected.

3. *Construction of roads and canals :*

Constructing and keeping up roads, as well as the needful ditches, thoroughfares, and bridges. Constructions for protection against inundations and swamping ; making of weirs and sluices.

4. *Exercise in drawing :*

The drawing of plans and of agricultural implements and machines, and designs for agricultural buildings.



Mr. Flint, in the account of his visits to European agricultural institutions, in 1863, thus speaks of his visit to Poppelsdorf:—

The agricultural college at Poppelsdorf, connected with the university at Bonn, is some ten miles above Cologne, beautifully situated on the left bank of the river, within sight of the far-famed Siebengebirge, or seven mountains, and the Drachenfels. It is reached by a magnificent avenue leading from Bonn to Poppelsdorf, studded with superb chestnuts in double rows on either side.

I called at once on Dr. Hartstein, the director of the agricultural school, who kindly gave me the information I sought in regard to its present position and prosperity. Close by his house is an ancient castle, now used as a depository of the extensive scientific collections belonging to the university, to which the students in agriculture have access. The model farm of the agricultural institute is also close at hand. This is used for the purpose of experiment, and the crops on the experimental plots were very striking. Extensive mulberry hedges surround the fields, and the silk-worm was in the full tide of successful operation.

The scientific lectures extend over not only the branches requisite in the department of agriculture, but also the fundamental and auxiliary sciences connected with it, viz.:—

(a.) Agriculture in its whole range as a leading science, and especially

1. The science of tillage, which is divided into a general and special branch. In the one are the knowledge of soils, manures, and the working of the land, the seed, care of the crop, and harvesting of agricultural products in general is taught; in the other, more exact instruction is given as to the judicious cultivation of each one of these products. In this connection the formation of permanent meadows, and especially artificial meadows, is considered.

2. The science of cattle-breeding or the production of animals, which also includes a general and a special course. In the first, instruction is given as to the different races, the pairing, breeding, feeding, care and fattening of cattle in general; in the second, the breeding of cattle, sheep, horses, swine, &c.

3. The proper farm management, taking in the whole agricultural profession, and including general rules and principles. The principal divisions are, the objects of agriculture, land, capital and labor, sale and leasing of estates, different systems of agriculture, the arrangements and direction of farms, and of taxation and book-keeping.

To these lectures upon agriculture are added those on fruit management, garden, fruit and vineyard culture.

(b.) Chief and auxiliary sciences.

1. The natural sciences, chemistry and physics, zoölogy, botany and mineralogy, with special reference to agriculture, and so far as they are of importance to the farmer in the oversight and judicious direction of his estate.

2. Mathematical sciences, especially applied geometry, stereometry, statics, hydrostatics and machinery, connected with the practice in field-measuring, leveling, drawing of plans, &c.

3. Popular agricultural literature, so far as it serves as a safe ground-work for practical agricultural instruction.

4. Agricultural technology.

5. Veterinary science.

6. Agricultural mechanics.

7. Laws relating to agriculture and the cultivation of lands.

8. History, statistics and literature of agriculture.

The farm connected with the institute serves for practical illustration, as well as the excursions which, from time to time, are taken in the neighborhood, and during vacations, also, into more distant regions. The institute is in want of no auxiliary means of making the theoretical and practical instruction most useful. Among these are the chemical laboratory, erected especially for agricultural investigation, the physical apparatus and the instruments for land measuring and leveling, the collection of minerals and ores, the zoölogical and veterinary collection, the collection of models and implements, and of wool, the library, the economic botanic garden, the botanical collection and the estate, with the experimental fields and the vineyard. Besides these peculiar means of instruction of the institute, the use of the rich collections and apparatus of the



university, the royal university library, botanic garden and natural history museum, is available.

Students pay an entrance fee of six thalers, and a fee for tuition of forty thalers, or thirty dollars, for the first term. The amount for the second term is thirty thalers, the third twenty, and the fourth ten, making the fee for the whole course of two years, one hundred thalers, or seventy-five dollars.

The lectures embrace a two years' course, the terms being arranged to conform with those of the university. The special plan of instruction is made known each term. The school is designed for those who desire to educate themselves for skillful farmers, and those who devote themselves to the studies of the university, and at the same time wish to become familiar with the operations of agriculture. Students who are entered at the University of Bonn, and enrolled in any of the faculties, can attend the agricultural lectures on application to the director.

Applicants have to bring certificates of good conduct. No proof of specific attainments in elementary school studies is required, but it is desired that, before visiting the institute, the pupil should be familiar with the practical manipulations of farming, and be able to show proof of it.

On admission, the student is matriculated and enrolled in the faculty of philosophy at the university. By this he acquires all the rights and undertakes all the obligations of the university students.

The whole establishment is under the control of the royal ministry for agricultural affairs at Berlin.

The experimental farm, close by the school, contains, I believe, about seventy acres. I visited the barns and out-buildings, all of which appeared to be in admirable condition, a place for every thing and every thing in its place.

But seven or eight cows are kept, and those are all Dutch, which are thought there to be among the best for milk. No experiments appear to be made there to test the comparative merits of different breeds. A long series of experiments in the fields near the house seemed to be conducted in the most careful manner. Many of the plots of wheat were of extraordinary growth. A great variety of plants are cultivated, chiefly for the purpose of instruction.

#### ROYAL ACADEMY OF AGRICULTURE AND RURAL ECONOMY AT ELDENA.

The superior agricultural school at Eldena is connected with the University of Griefswald. It was opened in 1834, and connected with the university on account of the vast manor connected with the latter, which was, moreover, suffering from lack of students.

It is governed by a director, who is at the same time teacher of agriculture and rural economy. The professors of the university give instruction in veterinary art, the natural sciences, and mathematics. The students must matriculate there, but are bound only for one semester. They must be over seventeen and must produce testimonials of good conduct and of having pursued classical studies. The instruction extends over two years, and includes:

1. *Political Economy*:—Finances; Rural police; Constitutional law in Prussia; Governmental organization; Politico-economic discussions.
2. *History and Statistics of Agriculture*:—Agriculture in general; Agriculture special; Cultivation of meadows; Zoötechny in general; Raising of sheep; Raising of horned animals; Rural economy; Systems of culture; Valuation of rural estates; Agricultural book-keeping, theoretic and practical.
3. *Sylviculture* in general, (culture of groves.)
4. *Horticulture*:—Culture of garden vegetables; Culture of fruit trees; Arboriculture, (culture of trees and shrubs for timber, &c.)
5. *Raising of Horses*:—Anatomy and physiology of domestic animals; Veterinary medicine; Hygiene.
6. *Chemistry*:—Experimental and agricultural, organic and inorganic chemistry, (exercises in the laboratory,) physics, and meteorology; Technology, with practical demonstration in the distillery; Brewery; Tile-kiln, and dairy; Excursion to the saline of Griefswalde; to the beet-sugar manufactory of Stralsund; Manufactory of instruments and mills.
7. *Anatomy, Phy-*



*siology, and Geology of Plants* :—Botany, general and applied to agriculture; Horticulture and Sylviculture; Zoölogy, general and applied to agriculture; Excursions. 8. *Arithmetic and Mathematics* :—Surveying; Leveling; General and applied mechanics. 9. *Drawing* :—Rural architecture; Practical estimates of constructions. 10. *Rural Law*.

It is liberally endowed and possesses a collection of machines and tools.

It has nine professors and eighty pupils, of which ten will devote themselves to the higher departments of government, where a knowledge of agriculture is needed. The fees are about \$90, board not included.

#### ACADEMY OF AGRICULTURE AT PROSKAU.

The Agricultural Academy at Proskau, in Silesia, was opened in 1847, and, up to 1867, had been attended by 1,067 students. Its curriculum is identical with that at Poppelsdorf. There are eight professors, and a farm of 2,312 acres.

There is also an inferior practical school for young farmers here, called *praktikanten station*. The instruction is given them by the administrator of Proskau and the farm-inspector at Schemnitz, in whose house they are boarded.

#### SCHOOL OF AGRICULTURE AT REGENWALDE.

The Superior Institute of Agriculture at Regenwalde was established in 1842. It has four professors, with a course like that given at Poppelsdorf. The fees are about \$221 per annum. The farm includes about 1,100 acres.

#### SCHOOL OF HORTICULTURE AT POTSDAM.

The gardening school at Potsdam was opened in 1823. It admits pupils who have passed two years in the preparatory school of Schönberg. There are six professors, and the course consists of a review of elementary studies, geometry, drawing, and the cultivation of trees, esculent vegetables, ornamental plants, and those employed in industry. The school possesses land for experiments, and a nursery of about eighty acres, whence fruit and forest-trees are sold.

There are about thirty pupils, of which ten or twelve are bursars.

#### SCHOOL OF FORESTRY AT NEUSTADT EBERSWALD.

The superior special forestry school at Neustadt Eberswald is administered and directed by the Minister of Finance. It was founded at Berlin in 1820, and united to the university; in 1830 it was removed to its present site.

The course lasts two years, with two terms in the year. The branches taught are forestry, general and special botany, the encyclopædia of the natural sciences, entomology, general and applied to forestry, phytotomy, vegetable physiology, mineralogy and geognosy, arithmetic, geometry, trigonometry, stereotomy, statics and dynamics. Conferences are held upon natural history, mathematics, political economy, and forestry; many excursions are made into the forests connected with the school, and one annually into those of the Elbe and Harz. Four botanical and surveying excursions are made weekly. For coppice-working there is a district appropriated to the school at Obersdorf, in Thuringia. The school receives only forty pupils.

The fees are fifty thalers the term. There are many bursars. Young soldiers who have practiced forestry and have served five years in a batallion of chasseurs, and can pass an examination in geometry, are received free into the school, continue to draw their army pay, and after two years, may present themselves at the examination of forest-inspectors.

## VETERINARY SCHOOL AT BERLIN.

The Veterinary School at Berlin has for its chief object to teach the art of military veterinary surgery, and almost exclusively of the horse.

There are nine or ten teachers and forty pupils. The course consists of anatomy, physiology, zoölogy, the veterinary art, and horse-shoeing, and extends over three years. There is an examination every six months, and one at the close of the course, after which the pupils enter the regiments or are assigned to posts. A clinique where sick animals are treated is connected with the school, and is free of charge, but their owners pay for food and medicines.

*French estimate of Prussian Agricultural Schools.*

M. de Laveleye, in the *Revue des Deux Mondes* for September, attributes the great advance made by Prussia in agriculture, first, "to the complete system of general education throughout the rural districts;" and second, "to the technical instruction provided not only for the manufacturing and mechanic classes, but for the agriculturists."

Prussia maintains four Royal Academies of Agriculture, at which both the theory and practice of farming are taught during two years, at a cost to each student of less than 8*l.* a year for instruction in political and rural economy, the management of trees and woods; in the mode of manufacturing sugar, beer, bricks and draining tiles; in mineralogy, geology, botany, and chemistry, with experiments and excursions; and lastly, in mathematics, trigonometry, land-surveying, practical mechanics, veterinary surgery, rural law, the history of their country, and constitutional law. Excursions into the most interesting districts are common. The persons who attend these academies are those who have to make their living by their own farms, commonly of small extent. For amateurs a less practical course is provided at institutes connected with the Universities of Halle and Berlin. There are nineteen provincial schools of agriculture below the academies, subsidized by the State to the amount of about 2,000*l.*, and generally taught by some large farmer, assisted by the neighboring apothecary, schoolmaster, and veterinary surgeon. There are also numerous special schools, for particular branches, such as market-gardening, and the cultivation of meadows and woods. The care of fruit-trees is taught in one hundred and thirty-four schools in the ancient provinces alone.

The system of paid instruction is extended by the institution of itinerant teachers, who go from village to village, criticising the cultivation and giving advice about rotation of crops and the most suitable kinds of manure. The State also maintains seven experimental institutes of organic and agricultural chemistry, which, on different soils and under different circumstances, are testing and completing the theories of Liebig, and in proving the quality of the artificial manures of commerce.

Finally, there are 519 voluntary agricultural associations, which by conferences, exhibitions and prizes, assist in spreading information. Apart from the academies and institutes of chemistry, the State does little. There is a central commission, presided over by a Minister of Agriculture, but its expenses in 1862 were only 177*l.* Three large stud farms, maintained at a cost of 20,000*l.* a year, continually improve the breeds of horses for war as well as peace. Eleven hundred stallions, distributed from these farms through the provinces, get annually 35,000 foals—a number sufficient to modify the breeds throughout the country in any desired direction in a very few years.

M. de Laveleye assigns much importance "to the simple and economic habits of the German farmer, and to the fact that Prussia is fortunate in having no Algiers, no large fleet, and especially no Paris to oppress agriculture by the drain of both money and men; but the great secret of the success of Prussian agriculture is diffused education and technical instruction."



## COMMERCIAL SCHOOLS.

In Prussia, the Real school, and even the Higher Burgher school, has been regarded as sufficient to give all the appropriate and special instruction required for a mereantile career, the practical part of which could, it was thought, be better acquired by a few years service in a subordinate position in the counting-room than in any school.

## COMMERCIAL SCHOOL AT BERLIN.

The Commercial School at Berlin, founded in 1848, by Dr. Schweitzer, and now under the direction of Dr. Frantz, has for its object the special preparation of pupils for commercial pursuits. There are but few schools of this special character in Prussia, as it is generally maintained that the gymnasiums and real schools afford the best general culture necessary to the merchant of good social standing, while the counting-room is the best practical school. However, the government has sanctioned this establishment.

The course of instruction covers two years, and there are four divisions: class III, class II B, II A, and class I. The branches taught are arithmetic, geometry, physics, history, geography, drawing, calligraphy; the history, geography, statistics, and science of commerce; history of mereantile staples, technical chemistry, laws of exchange, coinage, &c.; book-keeping, French, English, and German languages, and correspondence.

There is a Government Board of Inspection of the final examination. Successful candidates are excused from two of their three years' military service. From 1856 to 1862, 122 pupils passed, of whom 21 were characterized as "excellent," 64 "good," and 37 "passable."

The number of pupils was in 1862, 100 in the first year, and 140 in the second; in 1863, 173 and 176; and in 1864, 204 and 213; these statistics showing an increase of public confidence in the institution.

## COMMERCIAL AND INDUSTRIAL SCHOOL FOR YOUNG WOMEN, AT BERLIN.

The commercial institution for young women, at Berlin, was opened in 1866. Its purpose is to impart to young women already possessing considerable education, such theoretical and practical knowledge as will enable them to fill responsible commercial and industrial positions, especially those of book-keepers, accountants, and correspondents. It has seven professors.

The course is divided into two divisions; the first (A) extends over two years, giving general preparatory culture, with a view to future employment in commerce or industry; the second (B) of one year, suited to those who wish to obtain, as soon as possible, the knowledge necessary for entering at once into some practical employment. Ladies over 15 are admitted to Division A; over 16, to Division B. The subjects and hours, per week, are specified below.

General knowledge of commerce and industry; definition of commerce; different kinds of trade; auxiliary means of trade; coinage; weights and measures; money; banking and exchange business. The most important laws relative to commerce and industry, 1 hour during the first year; 2 during the second; 2 in Division B. Commercial and industrial book-keeping (by single and double entry,) 1 hour first year; 2 the second; 2 in Division B. Commercial handwriting and practice therein by writing themes on commercial business, 3 hours first year; 3 in Division B. Arithmetic general and applied to commerce and industry, 4 hours first year, 2 the second; 4 in Division B. German language and composition, 2 hours first year; 1 the second; 3 in Division B. German

commercial correspondence, 1 hour the second year; English language and correspondence, 3 hours both years; 2 hours in Division B. French language and correspondence, 3 hours in both years, and Division B. Drawing, especially free-hand and pattern drawing, 3 hours both years and in Division B. Stenography, according to choice. Elements of natural history, 2 hours in both years, and Division B, and the elements of physics and chemistry, 2 hours both years, and in Division B, to prepare for the study of commercial geography and history, 2 hours in the second year, and 1 in Division B, and the knowledge of goods and technology, 2 hours in the second year, and in Division B. Knowledge of matters connected with the vocation of women, more especially domestic economy, 1 hour in the second year.

The last branch applies science to domestic life, and treats the subject as follows: *Knowledge of sustentation*—alimentary substances, varieties, source, value for nourishment, adulterations, and tests. Animal and vegetable food in all its varieties. Cheapest and best diets. Cooking; materials for fire, utensils, modes of cooking. *Preservation of food*. Fermentations; putrefaction, and modes of preventing it. Various modes of preserving food; the ice-house; storing food.

Dairy products. Alimentary stuffs, and household goods, and materials. Care of house linen, nursing, sanitary laws, management of servants, accounts, and various other household functions.

The above plan of studies is only temporarily established, and is subject to change. Visits are made to workshops, goods depots, &c.

At the close of the course, after an examination, a diploma may be conferred.

The school fees are a matriculation fee of three thalers; an annual fee of 50 thalers; in Division B there are 10, additional for English, French, and drawing. Pupils are not received for less time than a year, but may attend single courses for  $1\frac{1}{2}$  to 2 thalers the course per semester. There are 49 pupils.

Connected with the institution is a collection of books, specimens of goods, physical, chemical, and technological apparatus.

#### SCHOOL OF NAVIGATION, AT STETTIN.

This school is intended to train mariners and masters of merchant vessels. It is under the superintendence of a director, residing at Dantzic, who has the same control over the other navigation schools in Prussia, and is provided with two professors and an assistant, who teaches drawing.

To be admitted to the lowest class, the candidate must be able to read and write, be acquainted with elementary mathematics, and must be able to make a fair composition in German. The lessons are given during 32 hours a week, and during three years, the first year being a course for pilots, while, during the last two is taught the art of navigating the high seas.

The course in pilotage comprises the following branches; arithmetic, plane geometry, carpentry, plane and spherical trigonometry, navigation, terrestrial and astronomical observations, drawing of sea-charts and astronomical maps, and English. That of the higher division comprises the preceding studies carried farther, rigging, drawing the different parts of a vessel, the commercial rules relative to ships' papers, and to the course of exchange at the principal commercial ports, &c.

On leaving the school an examination is held, and a certificate of proficiency awarded to those undergoing it in a satisfactory manner. This certificate is the basis of all promotion to any and the different stations of command of a mercantile vessel.

The fees, paid quarterly, are six thalers for the pilot's course, and ten for the higher course in navigation.



## MINING ACADEMY AT BERLIN.

The Mining Academy (*Berg Akademie*) at Berlin, gives a superior finishing education to persons connected with mines or the working of metals. It is governed by a director, and has a corps of nine professors, three attached to the school, and six connected with the University, who attend to give their practical courses. The pupils must inscribe their names for the courses they intend to follow, and persons not belonging to the school may hear single courses after the same formality. The school fees are calculated at the rate of  $1\frac{1}{2}$  thalers the term for each hour's lesson attended per week; thus a course with six lessons in the week costs  $9\frac{1}{2}$  thalers per half year. Laboratory manipulations cost 20 thalers additional, and assaying 10.

The course of instruction includes: 1. Mathematics; 2. Geometry; 3. Mechanics, elementary, higher, and applied; 4. Physics; 5. Construction of mining machinery; 6. Chemistry, theoretical, technological, and analytical; 7. Mineralogy, crystallography; 8. Geology, paleontology; 9. Surveying, general and practical; 10. Architecture, and construction in reference to mining; 11. Metallurgy, assaying by the dry and the wet method, and the blow pipe; 12. Mining law and business system, including book-keeping; 13. Drawing, through the whole course, with reference to construction, platting of grounds, sections, &c.

At the end of the course there is an examination, giving the pupil who passes it the title of *élève des mines* (pupil of mines). If he is to enter the State service, he must pass two more, the first, for the title of auditor of mines (*référendaire des mines*), after two years' practical mining; and the second, for that of assessor of mines, after two years' of administrative labor under a chief engineer.

The three professors attached to the academy and the director receive each 1,000 thalers a year. The total expense of the establishment is 12,000 thalers, and the part not covered by the receipts is borne by the State, which has also provided the building, the cabinets, and the apparatus. There are very complete geological and mineralogical collections, and very commodious and well-organized laboratories. Of the latter there are two, one for the dry and one for the humid method of assaying. Reagents are placed freely at the disposal of the students, only the more costly ones being given out under supervision.

## SCHOOL OF PRACTICAL MINING AT BOCHUM.

The Mining School at Bochum was founded in 1863, out of the surplus funds of a miners' association. The management is in the hands of the Director of the Mining Bureau, and of the trustees of the old miners' fund. It is designed for superintendents of mines, and master workmen.

The pupils must have worked three years in a mine before entering the school. They must enter early enough to finish the course before being called out to military duty, or else have finished their period of service.

The course occupies two years; the first year is preparatory and optional; the studies of the second occupy 30 hours weekly, and include mathematics, algebra, geometry, trigonometry, chemistry, physics, mechanics, and the elements of building construction, the law, administration and accounts of mining, and drawing. It is held only in winter, the summer being spent in work in the mines.

Instruction is gratuitous to indigent pupils only, who, if they give promise of excellence, find no difficulty in getting pecuniary assistance.

There is, connected with the school, an excellent library of works relating to mining matters and to the studies pursued, and a collection of geological and paleontological specimens.



## THE STEEL WORKS OF KRUPP.

In connection with this brief description of the School for Practical Miners at Bochum, which we compile from the letter of Mr. Samuelson, on "*Technical Education in various countries abroad*," we introduce a few extracts from the same letter, to show the commercial importance of the region of country, in which this and other schools intended to give a high scientific training to the engineers and foremen of the great industrial establishments, which the wise policy of Prussia now fosters and protects, are located :

The coal basin of Westphalia will be the foundation of an industrial development for the continent of Europe, second only to that of Great Britain. Its area is not yet fully ascertained, but the yield will last for centuries, even at a higher rate of production required to supply the steel and iron works now in full activity, and the numerous factories which are springing up through all this region.

At Essen, in the heart of the great coal basin and rich mineral district of Westphalia, are the celebrated steel works of Krupp. They consume 800 to 1,000 tons of coal per day raised from pits within the walls of the works or immediately adjoining, the cost at the works being less than 5s. per ton, probably the lowest cost of fuel in any metallurgical works on the continent. The machinery is as perfect as the magnificent products of the work would lead one to expect. The range of crucible furnaces is a sight of its kind unparalleled in the world, except perhaps at the neighboring works of Bochum. A steel 1,000-pounder breech-loading gun was nearly completed for Russia, and several 200-pounders and 300-pounder steel guns, hooped and rifled, also breech-loaders for the German Navy. Hundreds, I think I may say thousands, of steel guns, of every size, from those I have named down to 4-pounders, and for every nation under the sun, all rifle breech-loaders, but of endless patterns, were in every stage of progress, from the solid ingot, passing under the ponderous steam-hammer to the bored and turned gun, fitted with its breech-piece, and sighted. Besides the guns, numberless railway wheels and tyres were in progress. I may notice a number of forged cast-steel cranked axles, one of enormous size, for a transatlantic steamer, building at Greenock, by the Messrs. Caird, and several steel hoops for the Elswick gun factory. Nearly 8,000 men are employed at these works, producing 60,000 tons of steel annually, or more than twice the entire export of steel from the United Kingdom; and the human tide, as it pours from the numerous gates at the dinner hour, is not the least suggestive of the sights of Essen. At the outbreak of last year's war, (1866,) a thousand men were called under arms, but 250 of them were quickly sent back, lest the manufacture of cannon should suffer interruption. The administration is like that of a small State. All the heads of the technical departments are pupils of the various Polytechnic schools of Germany. The Commercial staff includes a jurist, by whom all contracts are settled, and legal questions determined. The foremen have all risen from the ranks.

In the very centre of the works stands the modest dwelling-house, and the very workshop in which Mr. Krupp succeeded to his father's trade at the age of 15, forty years ago, employing at that time a single journeyman at the forge, and himself traveling on horseback to sell his steel wares throughout the country.

The wages of the puddlers here are about 4s. per day, but it is probably above the average of the district. Rollers earn 4s., mechanics up to 5s.; the hammer-men, at the enormous steam hammers, 5s. to 6s.; their assistants, 3s. to 4s. 6d. Here again, there is no sub-contracting—the share of every man, in the tonnage rate, is fixed by the managers and paid to him at the pay-table.

The facility and certainty with which solid ingots of steel, weighing from 40 to 50 tons, are turned out of the works, are not more astonishing than the production of the largest as well as the most delicate moulded castings in steel at Bochum. The steel disc-wheels of Bochum, cast in a single piece, are now to be found on nearly every German railway, and while the price scarce exceeds that of iron wheels, their durability is incomparably greater; about 20,000 of them are already running. Bochum, like Essen, is in the Westphalian coal-basin.

Scarcely inferior in interest are the great iron and steel works of Hoerde, employing 4,500 work people. The heads of the technical departments here, as elsewhere, are pupils of the higher schools; the foremen are superior workmen.



## INSTRUCTION IN DRAWING IN PUBLIC SCHOOLS.

Drawing, since the establishment of the Academy of the Fine Arts in Berlin in 1690, and of the Real School by Hecker in 1747, has formed an important branch of instruction, not only in professional and technical schools, but in institutions of general culture, of the highest and lowest grade. In the classical and scientific schools, in the trade schools and further improvement schools, in the primary and secondary schools, we are sure to find its place in the programme of studies. In 1831, it was made a matter of special regulation by the Minister of Public Instruction, which was revised by the same authority in 1863, with suggestions as to the aims and methods of this branch of instruction.

The following Regulations for instruction in Drawing in the Gymnasiums and Trade Schools of Prussia, was issued by the Minister of Public Instruction (Von Muehler), October 2, 1863 :

Instruction in drawing is an important element in the education of youth, and forms an essential part of the programme of superior schools.

Experience has demonstrated that the actual state and results of instruction in this branch, as well as the development of scientific teaching, and the condition of art and industry, require a revision of the regulations of March 14, 1831. With the advice of the royal academies of fine arts of Berlin, Dusseldorf, and Koenigsberg, and of the provincial academic councils, and of several teachers of tried experience, the following regulations have been prescribed :

## I. PROGRAMME FOR GYMNASIUMS.

1. Instruction in drawing in gymnasiums is given in four classes or consecutive courses, the trade school constituting the fifth class.

Independent of this division of courses, pupils, as far as local convenience permits, shall be classed in special divisions, according to their capacities and progress.

*Lower Class :*

2. Elements of the theory of drawing ; lines of different directions, and dimensions in various combinations. Drawing of straight and curved lines without model.

In the first course, that steadiness of hand is not to be expected, which is necessary for drawing lines and circles with the perfection attained with the use of instruments.

*Second Class :*

3. First elements of perspective, with the occasional use of the ruler and compass if necessary. The pupils may draw after models of wood ; the apparent changes of aspect to which bodies are subject must be explained ; also the effect of light on the surface of bodies, and the shading of solids, beginning with those with plane surfaces. The models are to be turned successively to the right or left and placed at various distances from the pupil.

Moreover, in this class free-hand drawing after engravings is entered upon, advancing to parts of the face and to entire heads, giving at first only contours and slight indications of shade.

*Third Class :*

4. Advanced exercises in free-hand drawing after models and plaster casts, ornaments, leaves, parts of the human body ; copying engravings is to be continued, and landscape drawing to be begun.

Progressive development of perspective ; drawing from models in various positions and at various distances. Theory of the vanishing-point.

Introduction to the use of the ruler and compass in the principles of architectural design.

*Fourth Class :*

5. Free-hand drawing after engravings, arabesques, animals, heads, and complete figures ; more difficult landscapes.

Drawing from busts, full heads, use of stump and drawing with two crayons. Perspective continued to drawing apartments and groups of difficult objects not presenting too great difficulties.

## II. PROGRAMME FOR TRADE SCHOOLS.

6. The four preceding classes, comprising the course of a gymnasium, are also the first four classes in the trade schools, with the difference, however, that in the latter, free-hand drawing is taught to pupils of the superior classes, together with linear drawing (ruler and compass), beginning in the third class. The method of projections, on a plane or in elevation, is theoretically and practically exposed, and extended much farther than at the gymnasiums, while a greater number of hours also are devoted to instruction in drawing in the superior classes. Beyond this, the trade schools add a special fifth class to the course pursued at the gymnasium.

*Special or Fifth Class:*

7. Continuation of free-hand exercises; problems from perspective and the theory of shadows, with scientific explanations; exercises in linear drawing according to the special profession of each pupil; elements of topography.

8. As a close to the instruction in drawing, polytechnic schools can impose proofs of capacity upon pupils leaving the institute:

1. *Linear Drawing*.—A geometrical or prospective projection, including construction of shadows, simple objects in architecture, mechanics, or other branches. This proof implies the supposition that pupils of the superior course of a polytechnic school are able to trace back any graphic representation to its elementary geometrical construction; that they are familiar with descriptive geometry, with the theory of shadows and of perspective, and that they are sufficiently practiced in designing architecture and machines, without having completely exhausted the theoretical part of the branches.

2. *Free-hand Drawing*.—In this branch the individual disposition of each pupil should be considered; their inequality in this respect does not admit of a formal programme as definite as that for linear drawing. The more advanced pupils should be able to draw with the free-hand, arabesques, landscapes, animals, heads and entire from engravings, and various objects, including shaded heads from models in plaster, and prove their comprehension of the principles involved.

3. Drawing of plans and topographical drawing must also, to a moderate degree, become familiar to the pupils

To this programme are appended the following suggestions:

1. Instruction in drawing should proceed gradually from the most easy to the most difficult studies, avoiding that pedantic monotony which weakens the attention of pupils, and passing lightly over isolated details, accustoming the student at an early period to consider the whole. There is no want of excellent models for the first courses in instruction; but it is recommended that the teacher should sometimes make his own models that the pupils may see the method of constructing them. In the beginning the entire class should be engaged in the same problems in order to better sustain their attention and to elevate and stimulate their zeal.

2. The programme of instruction in drawing in the superior schools, particularly in gymnasiums, embraces also, besides the training of the eye and the hand, the development of the feeling for the beautiful. Pupils will learn by progressive exercises, to take in at a glance the characteristic forms of objects, and to properly appreciate the beauties of natural scenery and the master-pieces of plastic art.

3. Free-hand drawing is the most important exercise at the gymnasium, and the course should correspond with the indications of the programme, without becoming purely mechanical; but should, on the contrary, be pursued with the object of elevating the student to spontaneous and intelligent reflection. Nothing should be done by the beginner without previous theoretical and practical explanations. The education of the mind must accompany that of the hand; the latter can produce only what the eye sees, and the eye sees incorrectly without the aid of the understanding. The copying hand is not only an instrument in the service of the eye, but the auxiliary of a reasoning mind.



To attain this object, it is particularly important that the instructions should not be limited, as is often done, to the mere copying of engravings, a system from which science and method are almost always excluded. Drawing from engravings alone is injurious to the eye, because the object to be reproduced is always too near; and it will happen that pupils, after following a course in drawing through several years, will not be able to draw correctly even a chair or any other simple body.

4. Experience shows that most pupils leave the gymnasium to choose a profession after the third or fourth class, for which reason the complete drawing course for a gymnasium has been so organized that the pupil can acquire, before he leaves, besides some skill in free-hand and linear drawing, the theory of making plans and elevations as well as the elements of perspective; in short, they are sufficiently familiarized with the principles of design to pursue the course by themselves, if their vocation requires.

In gymnasiums the use of the ruler and compass in architectural design is reserved for the higher classes.

The education of the æsthetic sense, aimed at in all the other literary studies of the gymnasium, is also assisted by the study of models from the antique, and pupils in the higher classes should be made familiar not only with the classic antiquities, but also with some of the master-works in sculpture and architecture.

5. The polytechnic schools, by the terms of their organic regulations and to respond to their object, should initiate their pupils into a thorough knowledge of nature, science and art, by giving due importance to the instruction in drawing. By it, pupils should become accustomed to observation, in order that, by penetrating mathematical forms, they may be able to find and recognize them in all the natural combinations into which they enter, and to determine their peculiar and external characteristics. The better they understand the laws of nature, the more the sense of the beautiful will develop itself within them.

6. If, for the object of polytechnic schools, linear design occupies an important place in the programme, it is not with the desire that free-hand drawing be neglected; on the contrary, it should be cultivated in an earnest and methodical manner, always connected with instruction in perspective. It is recommended to add it to the plan of the fifth class, and if thought proper, to the preceding courses, in connection with lessons in natural science, and to introduce as a model the skeleton of the human body.

Before commencing linear drawing, properly so termed, the pupil should have acquired skill in free-hand drawing. This branch may begin in the third class, with the theory of projections, since perspective has been a subject in preceding classes, and may be continued with the theory of shadows.

7. Instruction in drawing should not generally pass the limits assigned in the programme of the school; its object is not to form artists, but to exercise pupils in the elementary principles of art, in the understanding of form, in sureness of eye, in the habit of estimating proportions, and in steadiness and skill of hand. Copying landscape studies is often dispensed with in higher classes, as the time and labor spent are out of proportion to the usefulness of the practice, and because both teacher and pupil are easily deceived by productions of this sort.

8. In the selection of studies, regard should be had to the needs of instruction, rather than to method and æsthetics.

9. Besides a collection of studies and models, it is indispensable that superior schools should be provided with a well-lighted hall specially adapted to this in-

struction, where suitable objects for observation, the copies of characteristic and celebrated works of art, busts, ornaments, fragments of architecture, etc., will be the best decorations. The daily contemplation of these models will contribute essentially to the development of the faculties concerned in drawing.

#### SCHMIDT'S METHOD.

In 1836, Mr. Peter Schmidt received a pension from the government in acknowledgement of the services rendered the schools and the country by a new method of drawing introduced by him into the Royal Real School, and taught by him to the teachers of the trade school and of the city normal school.

In this method, pupils begin by drawing from geometrical forms, made in wood or plaster, of a square pillar (seven and a half inches high and one inch and a half in its square section), a niche, and a low cylinder. The square pillar separates in joints, affording a cube and parallelepipeds of different heights. The hemisphere, which caps the niche, may be removed, leaving the concave surface of its cylindrical part. Each of these models afford a graduated series of lessons on the drawing of solids, and of curved lines, and the drawing of lines of different degrees of strength, and of shadows. This is accompanied with some of the more simple rules of shadow and shade. More difficult exercises follow from natural objects, and from works of art, or mechanism, according to the attainment of the pupil and the direction of his taste. An account of this method will be found in Prof. Bache's description of the Royal Real School of Berlin.

#### DUBUIS' METHOD.

The method proposed by M. Alexander Dubuis, of giving the human head, or bust, which presents only very general masses, or features; after this, another bust, with some additional indications of the head; then a third, in which the details are more numerous and more decided; and lastly, a fourth, in which the details are according to nature. These four busts, each placed in different positions, presenting four successive stages of the same figure, is in use in some public, as well as private drawing schools.

#### DRAWING IN COMMON SCHOOLS.

Although drawing receives some attention in the common schools, and the teachers are systematically trained for this purpose, its scope in Prussia is far more restricted than in schools of the same class in Bavaria and Wurtemberg. By the "*Regulativ*" of 1854, drawing in the Teachers' Seminary "must not go beyond introductory lessons in the linear representation of simple objects," and in the ordinary one class elementary school, it must not be taught beyond the simplest free-hand drawing from flat examples. Practically, it is not carried, as in the best Bavarian schools, into elaborate penmanship, tasteful as well as accurate map-drawing, ornamental designing, and the culture of the sense of the beautiful generally. Nor is it applied in the common schools, as in Wurtemberg, to the industrial details of the future occupations of the pupils. Instruction of this kind is reserved for the adult, or supplementary schools, and to the trade and art schools.

In the absence of any official directions as to the system of teaching drawing in this class of schools, we introduce a very valuable paper on the subject, prepared by Dr. Hentschel for Dicsterweg's "*Wegweiser*," a manual which has special reference to the organization, instruction, and discipline of common schools:



# DRAWING.\*

BY DR. ERNST HENTSCHEL.

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## I. DEFINITIONS.

“THE cultivation of the faculties of representation and form, gives us a feeling for beauty, grace, form, and symmetry.”—*Harnisch*.

DRAWING is a mode of representing solid forms by lines upon surfaces.

A drawing, as a result of artistic labor, has either a purpose outside of the art—such are mechanical drawings, plans, anatomical drawings, &c.—or it is executed for its own sake; as are landscapes, fruit pieces, &c. In the former case, their purpose is principally one of material usefulness; in the second, they are executed with an endeavor after a beautiful external form; and are thus a representation of the ideal. But those of the first sort do not exclude the beautiful, for every object, without any exception, can be beautifully represented.

Material forms are either natural or artificial; and either geometrical, or irregular.

Various species of drawing are practiced; as,

1. Linear drawing, which gives only an outline of the object; † and shaded drawing, in which surfaces are shaded.

2. Geometrical and perspective drawing. The first represents objects in their correct relative proportions as to magnitude; the second, as they appear to the eye. The geometrical delineation of one side of a body is called an elevation; that of its plan, a ground-plan.

3. Free drawing and sketching; either with or without the use of rule, compasses, &c.

4. Copying, or drawing from another drawing; drawing from nature, or of real objects; imaginative drawing, or drawing of things conceived of by one's self; of which the two former are of things as they are directly seen, and the latter are indirectly based upon the vision of real things.

In all drawing, the eye, the hand, and the sense of beauty, are employed; as are also, in drawing from memory, the faculty of conception, and in drawing from imagination, that faculty.

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\* Translated from Diesterweg's "*Wegweiser*."

† Many persons include in linear drawing, drawing by the aid of the compasses and ruler.

II. SCOPE, OBJECT, AND IMPORTANCE OF INSTRUCTION IN DRAWING.

Instruction in drawing should include—

1. Exercises in understanding

a. Form, in itself,

b. The beautiful in form.

These constitute culture of the eye and of the sense of beauty.

2. Exercises in representing

a. What lies immediately before the student; as in copying and drawing from nature;

b. What has heretofore been before him; as in drawing from memory and from imagination.

These constitute the education of the hand in the service of the eye; and culture of the memory, the imagination, and the sense of beauty.

From another point of view, we may distinguish as follows:—

1. Exercises in drawing lines, angles, and geometrical figures, as a basis for all studies in drawing; that is, elementary drawing.

2. Exercises in representing objects of all kinds, or applied drawing.

The chief advantage of drawing is the culture of the various powers which it calls into action.

*Training of the eye and hand.*—The knowledge of what God has made, and of what man has made, depends in great part upon the apprehension of the forms of things. Form, therefore, is one of the most important phenomena of the material world. And who will deny that the knowledge of the creation is important? God, who has made such various works, and has given us the power of accomplishing and being conscious of our own culture, must prefer not to have us go blind through the world. And to open a child's eyes, not only to the forms of nature, but to those of the world of art; so that he can apprehend and remember not only the form of a plant or an animal, the course of a river or of a chain of mountains, but also the architecture of an edifice, the construction of a machine, or the plan of a city, must be admitted to be of very great importance.

The training of eye and hand which drawing furnishes, is a means of acquiring this power. Not only do we become accurately acquainted with the form of what we draw, but the work of drawing sharpens our observation of the forms of what we do not draw. Thus, drawing affords a knowledge of the material world.

In addition to this, we acquire the power of representing forms to others in a visible manner. This is a power of universal importance. A few lines will often do more than a long description.

Training of the eye and hand is also of great importance, not



merely as a means of knowing what there is in the world, and of representing that knowledge, but also as a preparation for the duties of life. Thus it is of great use to many kinds of artizans to be able to draw a little, &c.

*Training of the conceptive faculty.*—Without this culture, the knowledge and understanding of the forms of the visible world is not possible. Through its exercise, the pictures are represented to the mind, from which the imagination develops new forms. And without the exercise of the imagination, it is impossible to conceive of any progress into the limits of the supersensual, the abode of religion.

*Training of the sense of beauty.*—This introduces us to that universal pleasure, that enjoyment exclusively possessed by none, which is derived from the beautiful in nature and art.

Every man, it is true, is to some degree fitted by nature to perceive and enjoy the beautiful, up to a certain point, but no further. He whose sense of beauty is not trained, loses infinitely. Take for instance the first example that occurs in actual life. A journeyman travels through a city full of beautiful architectural works. He goes stupidly in at one gate, and out at the other; there is no such thing as beauty for him. The buildings which he passes by neither have any present interest for him, nor will they hereafter be remembered except as masses of stone, rising high in the air, hollow within, accommodated with doors and windows, alike in one place and another, and erected merely from the necessity of security against wind and weather, thieves and robbers. But suppose another and better educated journeyman passing through the same city. How much delight will he receive through his cultivated artistic faculties? He will linger for hours, with the liveliest pleasure, before each building; and will go forward, stored with wealth of new studies, and remembering all his life with delight those impressions of his journeying-years.

The connection of culture in the beautiful with culture in morals is clear. In the recognition and the feeling, the loving and doing of the beautiful, coarseness and vulgarity, and tendencies toward debasing and sensual enjoyments, find a countervailing power. The virtues especially developed by the study of drawing are, persevering industry, love of unobtrusive right action, order, purity and decency.\*

A brief quotation from Goethe may conclude this introduction.

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\* Frederic the Great used to recognize his soldiers long after they had left the army, by the good order of their houses. An instructor in drawing might do the like. A boy who had attended school where, among other things, he had been obliged to learn the greatest neatness in writing and drawing, brought about at his return home a most beneficial reform in the external life of the whole family, by the vigor with which he opposed any deficiency in cleanliness and order.



The importance of instruction in drawing as a part of education, will best appear when we consider that by means of that acquirement we gain an increase of beautiful and noble pleasures derived from the external world. The whole realm of forms and colors opens to him; he acquires a new mental organ; he receives the most delightful ideas, and learns to recognize, to respect, to love and to enjoy, the beauties of nature.

Upon considering all that has been said of the intrinsic importance of instruction in drawing, and of its various practical advantages, we shall find that it includes no small number of qualities directly valuable as educational influences, both formal and material; and that it is accordingly an important aid in solving the problem of the common schools; which is, the bringing of the child to what is beautiful, true, and good.\*

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\* The hundreds who frequent a public museum can not sit comfortably in a liquor shop; and will soon come to feel that there is a direct contrast between men raised by art to the level of demigods, and men degraded by brandy to the level of beasts.—“*England in 1835*,” by Fr. von Raumer.

The more recent reforms in education make this department of culture a universal benefit, no longer to be enjoyed exclusively by the painter, the sculptor, and the architect. And to this end, the primary school must provide that the eyes of its pupils are trained, their hands practiced in certainty and accuracy of delineation, and their feeling for beauty awakened and cultivated. In this manner an important service will be done to the farmer, the laborer, the mechanic, and the manufacturing operative. The farmer who can draw, will be far less the victim of his own ignorance, or of designing enemies, in setting out lands and woods, in dividing meadow, arable land, gardens, in adjusting his tools, and in all matters relating to building, hedging, and irrigation. One who is undertaking to build, whether from pleasure or necessity, can, if his school instruction has enabled him, judge correctly by the preparatory drawings of the taste, strength, arrangement, and convenience of the proposed edifice, estimate materials and cost, and then save himself and his architect much vexation and now and then a lawsuit. A wealthy patron of the arts will thus be enabled to understand better the works of artists, to estimate thus more correctly, and to value more highly and remunerate more fairly the artists themselves. Indeed, there is scarcely any person who would not derive benefit from this most desirable study. It has also a moral value which is far from contemptible. Young persons who have learned to draw, will in that way occupy many vacant hours which would otherwise be passed in idleness, with all its evil consequences. The result of this can not but be beneficial in families; and when the young have themselves grown up, and are themselves fathers and mothers, the benefit will be still greater. But individuals as well as families, will reap similar advantages from it, through its efficiency in averting many harmful and prejudicial influences. Any occupation of a regular nature, and fitted to employ hours of recreation, is a rich source of pure and quiet pleasures, elevating both to the mind and the feelings.—Wirth, in the “*Universal Swiss School Gazette*,” vol. ii. p. 8, 9.

But setting aside all questions of mere practical usefulness, and therefore passing by the inquiry in what and how many human avocations drawing is useful and necessary—aside from all this, we know of scarcely any practice of more comprehensive influence than drawing. Instruction in it, in connection with that in the intuitional knowledge of geometrical forms, has an influence in stimulating and conjoining those two great elements of life, receptivity and productivity, unequaled by any other, so far as regards material existence. It makes demands upon eye and hand, upon mind and heart; and affords a methodical culture in accuracy, neatness, and in the sense of symmetry and of beauty. It offers the most efficient of all aids to instruction in natural history, natural science, geography, writing, and mathematics.—Dr. Zehlicke, in “*Mecklenburg School Gazette*,” vol. i. p. 3.

Drawing is not only a suitable occupation for the young, but sharpens the vision, trains the hand for writing and other delicate employments, gives practice in observation and quickness of apprehension, affords a store of instructions and ideas, develops the faculty of order and the sense of beauty, gives activity and cheerfulness, and is absolutely indispensable in many occupations.—Zerrenner’s “*Principles of Education and Instruction*.” Edition of 1833.



To aid in the actual solution of this problem is the purpose of drawing. If without it, it can not be completely and in all respects solved, the importance and indeed the necessity of it as a study are beyond doubt. It is always the duty of the common schools to give instruction in drawing; and only unavoidable deference to still higher necessities can exceptionally justify a temporary omission of it.

The actual state of affairs, it is true, argues against this opinion. In far the majority of the common schools, no instruction at all is given in it. Calligraphy is practiced with zeal and a great expenditure of time; a multitude of names of Asiatic rivers and Brazilian apes are committed to memory; and the most abstract grammatical relations are taught. But no care is taken to make the children familiar with the sphere of phenomena lying immediately around them, and to fit them better for real life, by means of drawing. The unpractical nature of the German mind is one reason for this; another is, that the Pestalozzian principle of a harmonious development of the fundamental human faculties, has, during the last ten years, not only not gained in currency, but actually lost. Whether this last fact is the result of our inability, light-mindedness and want of judgment, or of the truth that every idea has its periods of brightness and obscurity, is a question to be settled by others. To return to the practical view of the subject. The French are in this matter, as in others, more judicious than we. There the law enforces the teaching of drawing in all the elementary schools.\*

### III. APPLICATION OF THE GENERAL PRINCIPLES OF INSTRUCTION TO DRAWING.

#### A. *Outline of the Proper Exercises for the Common School.*

1. Both elementary drawing (of lines, angles, geometrical figures,) and applied drawing must be practiced; the former as a very necessary substructure for the latter, on the principle of beginning with the elements; and the latter, because the forms of the world around us,

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\* The Royal Government of Magdeburg, in a circular order to the common and burgher schools on the subject of drawing, of April 6, 1847, reproves the neglect of it; which is the more surprising, inasmuch as there is scarcely to be found one school inspector who is not convinced "that drawing, which is in itself an occupation appropriate for the young, and of an innocent character, sharpens the vision, quickens the hand, trains the attention and the apprehension, conducts to intuitions and to ideas, develops the faculty and the sense of beauty, prevents tedium and idleness, and is of great pedagogical importance; and who does not know how many occupations require a knowledge of drawing; and that, especially at the present day, when such rapid progress is made in all industrial pursuits, drawing is a study absolutely indispensable." And the circular adds, "It is very true that at present, many things are studied in our burgher and common schools, and in many ways. But it is also true that all such studies, whenever they exceed what is necessary, should not be permitted; and that therefore the school department has long been endeavoring to fix the proper limits to the field of study; and that for a study so important as drawing, the necessary time *must* be found.

without comprehending and representing which neither the formal nor the material object of drawing will be reached, are almost always not plane figures, but solid forms.

The educating power possessed by elementary drawing, is not doubted even by its opponents. Nor does it deserve the common accusation of dryness and wearisomeness, if properly commenced and continued. Experience shows that boys find an especial pleasure in dividing an angle into three, four, or more equal or proportional parts, in constructing an equilateral triangle, an octagon, a circle, &c. Many maintain that the fundamental forms should be practiced only in real drawing—in drawing actual objects. But this would destroy a portion of the expected advantages; for besides the fundamental forms, all the collateral work which drawing from nature requires, must be repeated exactly as often as the fundamental form; usually without any benefit. An equilateral triangle must be drawn correctly, not merely once—for chance may bring that about—but twenty times; which would show that chance has nothing to do with it, and that certainty of execution has been obtained. But who would need to design twenty times over the whole decoration of which the triangle may form a part?

2. In applied drawing, exercises in drawing by hand and outline sketching, perspective and geometrical drawing, copying and inventive drawing, should, none of them, be wholly omitted. But as a general rule, the drawings in all these departments should be linear only, and not filled out by means of any shadowing.

The practice of free off-hand drawing is evidently indicated as necessary, by both the formal and material purposes of instruction in drawing. This formal purpose requires as great a variety of stimuli as possible. These can not be conceived of without free off-hand drawing. In respect to the material objects of drawing, the pupil who restricts himself to outline sketching, must give up the idea of representing a very large number of forms which could well be produced in free off-hand drawing. But there should not be such an omission. Instruction should be in accordance with nature; and this requires that the perceptions of the pupil should be directed to the whole world of nature and art.

With reference to the other kinds of practice, may be mentioned—  
a. *Reasons for practicing outline drawing.*

The great accuracy which this requires, affords a peculiarly good practice of hand and eye, and has, in particular, great value as a training to observant, judicious, and provident activity. Any one who has accustomed himself to go about with circular and ruler, square



and pencil, is much readier at apprehending than those who are ignorant of the use of them. Many objects in practical life, also, can not be drawn except in outline.

b. *Reasons for practicing copying.*

1. The requirements of actual life demand it.

2. A harmonious culture of the artistic faculties is impossible without practice in copying; and this both with reference to the technics of art, and to the cultivation of the sense of beauty. Such a culture doubtless requires in particular that the pupil should accurately comprehend a large number of given forms. But the mathematical part of drawing implies much less apprehension than representation, and even this only according to fixed and very simple relations. Drawing from nature again affords, more especially, training in apprehension; and the subjects selected may be as difficult as is desired; but still, only a relatively very small field of forms can thus be introduced into the common school for actual apprehension and representation. In drawing most animals, for instance, there would be very much discipline for both eye and hand; yet animals could hardly be made models for drawing in the common schools. The taste, again, would be very much cultivated by the study of classic architectural ornaments; but it is out of the question to go to Cologne or Strasburg to draw those there, not to mention crossing the Alps. Thus the necessity of copying becomes clearly obvious.

c. *Reasons for drawing from nature; geometrical (elevations) and perspective.*

1. The pupil improves in power of apprehending the various forms around him,\* and in remembering them.

2. It enables the pupil to understand perspective drawings immediately upon seeing them.

3. There are frequent occasions in actual life when it is important and even necessary.

4. As an immediate, free and independent mode of reproducing what the eyes perceive, it has an entirely peculiar attraction for the pupil.

5. Acquaintance with the laws of perspective introduces the pupil to an entirely new world of ideas and thoughts; and it is certain that such an occurrence can not be without influence upon his general intellectual development.

These reasons in favor of perspective drawing, founded both upon the formal and the material purpose of instruction in drawing, are not

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\* "It is astonishing how many deceptions remain undiscovered without the practice of this art, and how invariably we see otherwise than as we suppose."—*Otto*.

without weight. There can be no complete instruction in drawing without that in perspective. If perspective has hitherto found little or no favor in our common schools, the reason is, partly the undeniable difficulty of the subject itself, and partly the lack of time, room and apparatus. It can therefore perhaps never be a universal study. But in all schools where space and time are not too limited, at least the more advanced pupils should make a beginning in perspective. Some details on this point will be given below.

d. *Reasons for practicing inventive drawing.*

1. The power of producing the beautiful already exists in the child, and shows itself in innumerable ways. We must develop it if we desire to avoid a one-sided culture.

2. It is certain that, as Otto says, this independent creation of beautiful pictures elevates the pupil to a consciousness of the rays of that divine creative power which appears in the human imagination.

3. Practical life often calls for ability to arrange or construct in a tasteful manner. Many mechanics could not get on without the faculty of inventing beautiful forms.\*

e. *Reasons for and against drawing with shaded surfaces.*

aa. For.

1. It affords a knowledge of light and shade as found in the world without; that is to say, of one distinct aspect of the phenomena of objects.

2. It relieves the pupil from his dissatisfaction, upon comparing his unshaded sketches with the common shaded pictures, and discovering his own to be comparatively incomplete.

bb. Against.

1. It is of but little value, in comparison with a knowledge of outline drawing, in regard to the apprehension of objects in nature and art. Light and shade change continually, while outlines are more permanent.

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\* Although I use the word "inventive" in an entirely general manner, the term of course naturally applies to the invention of symmetrical figures from modifications of the fundamental mathematical forms. I am not of the opinion of those who think that such exercises should be rejected on account of the lack of reality in such figures.

Those who doubt whether such figures can be called beautiful at all, seem to doubt also whether the habit is to be approved which has prevailed for so many centuries, of using such forms on walls, doors, windows, fireplaces, hangings, cupboards, tables, furniture, carpets, table-cloths, book covers, embroidery patterns, and in a hundred other such ways. But the fact that these objects do certainly exist, and that other similar ones continue to be designed and used, so that the figures in question do in fact have a relation to real objects, is a sufficient reason for not omitting them from instruction in drawing.

Otto states the necessity of the three principal departments of drawing, viz., copying, drawing from nature, and inventive drawing, as follows: "Drawing from visible bodies trains especially the eye; drawing forms kept before the mind by the imagination and produced by it, and still more the work of imagining them, trains the imagination; and the copying of pictures already executed, the sense of beauty."



2. For such drawing as is required in practical life it has sometimes no value, and at other times a very subordinate one.

3. If not very well prepared for and very well managed, it frequently produces a bad effect, and thus obstructs the cultivation of the taste instead of promoting it; and even renders the minds of immature scholars obscure and stupefied.

4. It wastes time needed for other most indispensable exercises.\*

These reasons on both sides indicate that this department should be studied, but that its practice should be confined within somewhat close limits. Only remarkably talented and industrious pupils should be permitted to pursue it, and then not unless they have prepared the way by a thorough practice of outline drawing. Those collections of copies for drawing are quite unpedagogical, in which every thing is shaded, even from the very beginning. Unfortunately there are so many such, that more proper points are too often entirely omitted.

Having thus discussed the necessity of studying in the common schools the various departments of elementary and applied drawing, free off-hand drawing, outline sketching, copying, drawing from nature and inventive drawing, the next inquiry is,

*B. The relations of these different departments of practice to each other.*

1. Elementary drawing is the basis for all the others, and is therefore the first step.

2. Perspective drawing from nature is the most difficult, and therefore should constitute the last or fourth stage.

Want of elementary practice has an astonishing power of interfering with the results in perspective drawing. This latter, moreover, requires a certain maturity of the whole man; and it is also less important for ordinary use than the other kinds. And in the small extent to which it can be learned at the common schools, it can have but a small influence, relatively, in developing the sense of beauty. All these considerations indicate that perspective should be the last department taught.

3. Outline drawing is not to be taken up with the elementary

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\* The shading is certainly a main reason why, in so large a share of the common schools, notwithstanding all the time spent in drawing lessons, the people do not learn to draw. As soon as Johnny has practiced lines and outlines for a few months, he is given a large fruit-piece, a group of animals, a landscape, or a head, to shade. The outline is very quickly executed, for the circle is used; and "the circle is on purpose for drawing outlines;" and on he goes, with his shading. For twenty or forty lessons, he sits scratching vacantly, humming and thoughtless, until the wonderful work is completed. Then it is glazed and framed, is handed all round at the examination, stared at and bepraised by people who do not understand it, and our young hero, who can not draw a right angle, nor sketch a window, and who has no idea of beauty of form, receives a prize. At home, they hang up the picture with great ceremony, "in everlasting remembrance," in the best parlor. Poor Johnny!

course, but should come later, immediately before drawing in perspective from nature, except so far as it belongs to geometry, and is employed in the construction of purely geometrical figures. It thus should constitute the third step, or last but one.

On the subject of practicing outline drawing in the elementary course, opinions differ. Ramsauer says that it would be an unjustifiable waste of time to work with ruler and circle before the eye and hand gain firmness. Hippius directs a whole series of elementary exercises with the ruler, before beginning free off-hand drawing. Most teachers of drawing are of the opposite opinion to this. We incline toward the side which experience seems to have indicated, namely, that of the majority.

4. Between elementary drawing and outline sketching is the place for free off-hand drawing, applied to actual objects; which thus occupies the second place.

5. Having thus determined upon four principal departments, the question will come up, Where does copying come in; and elevations; and inventive drawing? We answer:

*a.* Inventive drawing has already been practiced in the elementary stage. But the pupil must always be made master of the materials with which he works; he must have seen specimens of inventions of the sort which he is expected to make.

The child can not develop the idea of the beautiful from himself. Some of the Pestalozzians have erred to an unspeakable extent on this point. Never was a more unpedagogical problem proposed than that of J. Schmid, for beginners—"Make a beautiful combination of isolated points!"

But where the imagination has been set in action by examining models, the pupils may be permitted to make some experiments in invention, for which reason we have admitted it as above. For it is certainly according to nature, to begin to develop the different phases of the artistic faculty in children, from even the very point where they begin to spring out. We must, it is true, have regard to the old motto, "*Non multa sed multum*;" in order that we may not, in avoiding one-sidedness, fall into the opposite error of studying too many things at once.

*b.* Drawing from nature, so far as it consists in making simple elevations, may be practiced during the second stage. For those just beginning it is too difficult, principally on account of the usually necessary reduction to a diminished scale.

*c.* Copying may be commenced in a very easy way, as soon as a good beginning is laid in elementary drawing.



All the preceding details may be grouped as follows, in a

*General Scheme for Instruction in Drawing.*

*First Grade*, or Elementary Drawing; and in connection with it, Inventive Drawing and Copying.

*Second Grade*, Application of free off-hand drawing; including Copying, Geometrical Drawing from nature, and Inventive Drawing.

*Third Grade*, or Outline Sketching; with a continuation of Copying and Inventive Drawing.

*Fourth Grade*, Perspective Drawing, exclusively.

This plan is in accordance with nature, as relates both to the pupil and to the subject.

C. *Directions for further practice in the different departments.*

GENERALLY.

The same principles which have been laid down relative to the succession and connection of the various departments of practice, are applicable also to the choice and selection of the materials for each separate one.

It is therefore necessary,

*First*, To draw various forms. For if the instruction given is to communicate any formal culture, the child must, as has been said, comprehend its entire scope. It is an error to choose artificial forms only, or natural forms only. The teacher utterly misapprehends the character of the common school, who causes architecture, or tools, or flowers, or landscapes, either of them exclusively, to be drawn. The pupil does not see either of them exclusively; nor is it the business of the common school to educate especially for any one occupation such as that of the carpenter, the cabinet-maker, potter, &c.

*Secondly*, It is the universal rule to begin with what is easy, and to proceed from that only with great caution. Now the easiest part of drawing is that with right lines; not perhaps where the fewest lines are used; but where the relations of lines and angles are easy of comprehension. Of the regular forms, for instance, an easy one is the regular octagon; and a difficult one, the regular pentagon. Irregular forms are easy, if they are derived from regular ones; as, for instance, the semi-circle; but difficult otherwise, as in the case of the eye, nose, ear, hand, &c.; all animals; most flowers and fruits; all trees; most tools, &c. Thus many of the designs most frequently given to children as elementary exercises, are entirely improper for the purpose; and great care must be taken not to be led astray by such titles as "*The Little Flower Draftsman*," "*Elementary Exercises in Landscape Drawing*," "*Studies of Animals for Industrious Boys*," &c.

The principal disadvantages of selecting too difficult subjects to be copied are, waste of time, discouragement of the pupils, or else vanity and overestimate of their powers. And in schools where there are several classes, a teacher who proceeds in a thorough manner, will find himself cast into the shade by this faulty mode of proceeding by his colleagues.

“But the children will not work well at easy exercises.” Unfortunately this is too true. They want to make a great picture, of the market-place at Leipzig, and that, if possible, during the great Easter fair; the shipwreck of the Medusa; St. Genevieve; the battle of Katzbach, &c. But it will not do to permit this. The more difficult it is to bring the children, by a course of instruction unbroken, and yet interesting, appropriate, attractive and not wearisome, to the point where they will find their pleasure in solving with certainty the problems laid before them, instead of in their extent, so much the more zealously should we labor to accomplish it.

But even the most careful arrangement of the order of problems will not avail, unless,

*Thirdly*, The pupils receive the necessary explanations and assistance. Here failure is frequent. Perhaps the pupil is set to copy a flower. He begins at once, at one of the extreme points; and goes on to draw leaves, anthers, petals, pistils, &c., one after another, as zealously as possible, down to the minutest parts and details. After long and careful labor, his flower is finished; an excellent flower, but unfortunately quite different from the original. There are schools where drawing is practiced in this manner, year after year. But how easily would the pupil have accomplished his work in the case proposed, if he had at first been taught how to see the blossom correctly. The fundamental form would have been laid out perhaps by three or four points; and all the details would then have fallen into their places of themselves.

It must be plainly said, that in most drawing schools, instruction in intuition and apprehension is unjustifiably neglected. Many teachers have scarcely any idea of the basis of all drawing, of which the judicious Bräuer, in his “*Theory of Free Apprehension*,” has observed, “Before any figure is drawn, it is necessary that it should be seen or understood in all its parts and relations.” Here is a principal reason why so little progress is commonly made in this study.

But supposing that all the conditions hitherto laid down have been complied with; then, lastly and

*Fourthly*, It must be strictly required of the pupil, that he draw well; that is, correctly and with entire neatness. No botching or



working over, indistinctness or fancifulness, smearing or rubbing, trifling or talking, will accomplish this. The whole of the pupil's power must be earnestly and perseveringly exerted upon his work. It is only by this means that drawing will become the important educational instrumentality that it may be made.

Working in company is much to be recommended. The task may be given out, the mode of performing it stated, and then followed at the same time, from point to point, by all. This trains to intelligent, orderly and regular labor. It is unnecessary to argue that all possible means should also be tried to enlist the interest of the children in the work which they are to do, and to conciliate their love of it.

#### DETAILS.

##### 1. *Elementary Drawing.*

a. Should elementary drawing follow geometry, or geometry drawing? Neither, and for this reason; that the order of study of the two subjects must often be very different. Geometry considers the triangle before the square; while in drawing, many squares may be considered before many triangles are. And much that pertains to geometry is of no importance to drawing. For it results from the nature of the case, that the portion of geometry which is of use in drawing, is studied during intuitional instruction, and therefore long before drawing is commenced. Such points are, ability to recognize a right angle, a square, a circle, &c. I find no use in connecting geometry with drawing. But it is a different thing to repeat while drawing the fundamental forms, that part of geometry which relates to them. This will aid in thorough comprehension of the case, and is to be recommended.

b. There are elementary exercises which consist in drawing right and curved lines by the children together by beat, large free lines, if possible with a movement of the whole arm. These exercises are of great importance; they should be practiced at the same time with such others as require the closest care, and where therefore the pupil is working more by himself and in detail.\*

c. Exercises in estimating the lengths of such straight lines as may be found at hand, by natural or artificial means, may, from time to

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\* The opposition of many of Peter Schmid's pupils to this class of exercises, has for a long time been much less violent. Ramsauer says, "Brief and definite orders, and prompt and uninterrupted work according to them, regulated by keeping time, will accomplish an infinite amount of good in acquiring any kind of manual skill where practice is the thing required. While on this point, a word should be said of the applied art of writing. Markwordt, of Berlin, practices much in large free strokes. A great part of the so-called 'American method in writing,' also consists of large free movements in unison; and the results are so evidently good, that the system is daily coming more into use."

time, be introduced between the drawing exercises proper, but should not be carried too far.

*d.* In arranging the subjects for practice, the objective and subjective order should be, as far as possible, united. According to the purely scientific or objective arrangement of the fundamental forms, the equilateral triangle should come before the rectangle; but in drawing the order should be different, because the latter is much the easiest to draw. The same is true of the pentagon and octagon. A course of instruction arranged with reference to subjective principles may, it is true, at first seem disorderly rather than orderly; but a more acute vision will discern the "red thread" which leads through the whole.

## 2. *Copying.*

*a.* Subjects beautiful in themselves should be selected for copying. For example, a finely formed vase should be selected rather than a common kettle. The faculties used in drawing will be as well trained by one as by the other, while the former is of greater value in developing the sense of beauty.

*b.* For beauty of execution, only the very best designs are sufficiently good; those only moderately well done can not go.

*c.* For the purpose of working in classes together, the use of designs large enough to be seen by the whole class—those made to be hung up—is much to be recommended. An industrious teacher will even, if necessary, prepare such himself.

It is still more important that the teacher be able to design on the blackboard. Hippius says, "The children can see the drawing constructed; can watch the beginning and the end of it; and can obtain more thorough ideas as to apprehension of objects. They should themselves proceed to imitate these drawings, which should be suited to their capacities, on a smaller scale. The manipulation of the work should be such as to serve as a model to the children; the teacher locating in the proper places the necessary initial points, in a careful, I had almost said a learner-like manner. When the figure on the blackboard is complete, it should be analyzed, and understood both as a whole, and in the relations of itself to its parts and of the parts among themselves. After this mode of intuitional study has been sufficiently practiced, the teacher should again go through with the process of drawing the figure, as it were in his thoughts, by dictating the work point by point. At the same time he should pass round among the benches, directing and assisting wherever necessary, reproving or praising, and endeavoring to keep all the pupils in cheerful activity.



*d.* Even when the children draw each by himself, after small separate originals, they should often be made to draw their copies on a larger or smaller scale, for the sake of gaining in freedom of conception.

*e.* With an eye to the ultimate and principal purpose of instruction in drawing, it will be better for the pupils to sketch many objects with few strokes, than to occupy the same time over a few drawings, more elaborated. But these latter should not be entirely excluded. The best mode is to produce, from time to time, some larger work, and to draw between or along with these many sketches not so much finished in detail as full of meaning.

*f.* For copying, more reference should be had to the sex of the children than was the case in elementary drawing. Thus, architectural subjects should be chosen for the boys, and beautiful vases for the girls; weapons for the former, flowers for the latter, &c. One-sidedness in selection should, however, be avoided. The girls should be made to comprehend the beautiful forms of the higher departments of architecture, and the boys the characteristics of leaves and fruit. In short, to repeat the principle once more, it is the whole world of forms which the school should prepare its pupils to comprehend.

### 3. *Inventive Drawing.*

*a.* This may be practiced both upon spontaneous conceptions and upon real things. In either case, the pupil may be required either to complete a design, to decorate it, to vary it, or wholly to invent it. For instance,

1. Ideal representations. Completion—to draw the whole of some figure from half or a third of it. Decoration—to ornament a rectangle with lines all converging to its center. Variation—to change a regular octagon into an irregular one. Entire invention—to draw a group of equilateral triangles and decorate them at pleasure.

2. Real objects. Completion—to draw a window, having one quarter of it given. Decoration—to ornament a design for a table top. Variation—to change a quadrangular window into one with curved lines at the top. Invention—to design a beautiful trellised gate.

The usual order of these exercises should be, first, free representations of real objects, together with drawing mathematical figures. Completing a design is usually easier than decorating it, and that again than varying it; while absolute invention is the most difficult of all. The lessons should be arranged in accordance with these principles.

*b.* Occasionally an entire class, or at least a section of it, should

work together at invention. If, for instance, the problem is to decorate a square, the children may step up to the board, one at a time, and work upon a square drawn upon it. This will furnish many opportunities for remarks, and the inventive faculties of each pupil will benefit all.

c. Sometimes the pupils should merely sketch their conceptions without completing them; and the teacher may then criticise the sketches. In this way, several designs may be sketched at one lesson. The slates may be sometimes exchanged about in such a manner, that each pupil can see the designs of all the others.

d. Invented designs which are to be finished in detail, should be approved in outline, to prevent expending hours of the pupil's labor on a design which may, perhaps, at last be rejected.

#### 4. *Drawing from Nature.*

*First*, as to geometrical drawing from nature.

a. Either actual objects, such as are about the children, should be drawn, such as doors, gates, trellises, floors, windows, cupboards, stoves, monuments, &c., or there should be used, as Otto very judiciously recommends, an apparatus on purpose, by means of which all sorts of figures can be set up together, on a ledge on the blackboard. The drawing may either be of the natural size or on a reduced scale. In the latter case, great care must be taken that the children shall justly estimate the relative sizes of the reduced objects.

b. Just at this point it is of especial importance that, in the beginning especially, much work should be done in common. Before the children put pencil to paper, they must fix upon all the relative dimensions, not by means of a mere cursory view of the object, but of a careful survey of it. It should be a point of honor to come as near as possible to correctness. When all the estimates have been made, the teacher may name the dimensions before the class; and then they may proceed to draw.

c. This is a very appropriate place for tasks to be performed at home. "Draw the front of your father's house; the windows of the sitting-room, &c. I will take occasion to compare the drawings with the originals." And so on.

About this time a beginning may be made with perspective drawing, perhaps somewhat as follows:—

a. Practice the children in seeing real objects in a perspective manner. This is not very difficult, and has the advantage of showing the pupil what perspective is, even if he does not become able to draw on its principles.

b. Perspective may be taught by copying. Perspective designs may be given to be copied, arranged in a progressive manner, and



instruction on the laws of perspective may be given at the same time. This is the method of Soldan, Warmholz, and others; and is not liable to any weighty objections.

*c.* Exercises both on copying and seeing should be practiced.

*d.* Drawing from real objects should be practiced, either by section of the class at once, or singly.

Drawing is of course a more useful exercise than mere seeing; and drawing from real bodies is better than from another drawing. And it is better to display the article to be drawn conveniently upon a table for one, two, three, or at most four scholars, than to elevate it somewhere for the whole class to draw from.

The circumstances must govern in each particular case. I would however have some exercises in seeing, in every school where drawing is practiced at all. I add a few hints for such as have proceeded far enough to draw real bodies.

*a.* To complete the shading of what is drawn should be unconditionally forbidden. The common school has no time for this, if the children are to be made at all acquainted with perspective.

*b.* The subjects should not be too difficult; such, for instance, as plaster heads, landscapes, groups of animals. The principal thing is to teach the children to comprehend and represent with ease the simplest perspective appearances.

*c.* The children should not be troubled with difficult theories of perspective; nor, on the other hand, should they be restricted to the brief rule, "Draw what you see." Some knowledge of the laws of perspective is indispensable for the moderately and less capable pupils, as well as an acquaintance with some simple means of aiding in seeing in a perspective manner.

*d.* These laws of perspective, however, should not be given, but discovered. It is wrong, for instance, to tell a pupil that a circular surface or thin body can be seen as a straight line, and then to hold it up to him that he may be convinced of it.

*e.* The most practical possible application should be made of the principles which lie within the scope of the common school. These should be joined to the exercises on cubes and prisms, for instance, a drawing of a chimney, a chest of drawers, an open door, &c.; and the best scholars may afterwards draw a house, a bridge, a gateway, &c.

##### 5. *Outline Sketching.*

*a.* The common school is not the place for designing pillars, capitols, and similar architectural constructions. They belong to the industrial school. The business of the common school is limited to this: 1. Geometrical construction of lines, angles, and figures; 2.

The application of these to the drawing of simple sketches and ground-plans.

*b.* Great skill may be attained in this kind of drawing, so far as it can be carried with the aid of the simple instruments which the children can be trusted to use. Without using these, the practice would do more harm than good.

*c.* The use of the circle and ruler must be industriously practiced, in order to the acquisition of skill in it. Many simple problems should be given out for using them; as, for instance, to draw four angles one after another, each half as large as the preceding; to magnify to many times its own size, &c.

*d.* As to selecting subjects for ground-plans and elevations, the following suggestions may, perhaps, be of service:—

1. Select for drawing, a plan of the school garden; the church-yard; of some building, as the church; an elevation of the school house, &c.

2. Let the children copy some plans, ground-plans, elevations, &c., in order to become acquainted with the usual mode of doing such work.

3. Let each pupil himself make out some such plans, ground-plans or elevations of his father's house or garden, &c.

#### D. *Course of Study.*

This is rather to indicate one mode of arranging the work, than to be followed to the letter.

1. *Common schools of three classes.*—Drawing should be practiced only in the middle and higher classes; not in the lower. It is safe to calculate that children of at least three different grades are always to be found in each class; so that divisions must be made. More than two such divisions are usually too many, as experience indicates. Thus each class will have a two year's course, and each pupil will, at least in that part of the study where the whole section works together, go twice through one of the halves of the course.

*a. Middle class.*—Here it will be well to permit the capacity and industry and progress of each pupil to determine which half of the course he shall go twice through with. The course should be as follows:—

##### *First half—*

1. Elementary drawing. Lines, angles, the easiest divisions of lines and angles, the rectangle, isosceles triangle, square, rhombus, rhomboid, equilateral triangle. Straight and curved lines together, by beat.



2. Copying. The simplest forms with straight lines, partly representations of real things, partly variations of fundamental forms.

3. Invention. The easiest exercises in completing and varying forms; usually to be executed in common.

4. Beginning of estimating dimensions; usually of those where one of the dimensions to be estimated may serve as a measure of the others.

5. Examination of the model drawings.

*Second half—*

1. Elementary drawing. Continuation of the division of lines and angles. The regular hexagon. The regular octagon. Different curves on straight lines, and half and quarter circles. Irregular polygons; waving, serpentine and spiral lines; the circle, ellipse and oval. Curved strokes together, by beat.

2. Copying. In the first half year of designs with straight lines only; in the second, of those with curved and crooked lines. The straight lines should always be in simple combinations; the curved ones in connection with straight ones; and easy flowers and fruit given only to the most capable of the children.

3. Invention. Tasks somewhat more difficult, but no designs of real objects yet to be permitted.

4. Drawing from nature. Very easy elevations; and only to be practiced as a secondary exercise.

5. Study of model drawings.

6. Estimating dimensions; partly with and partly without the use of the legal measures of size and distance.

*b. Upper class.*—Here the scheme must be a little more carefully arranged. I suppose the children to draw in perspective only during the last year of school, and then during both lessons; so that their copying and inventive drawing must be done at home. The children of thirteen years of age, again, should form one section, (Section 1,) and those of eleven and twelve another, (Section 2.) Then the instruction for the year may be arranged as follows:—

1. From Easter to St. John's day. For Section 2, off-hand drawing; exercises in copying and invention. Section 1, perspective; first beginning.

2. From St. John's day to Michaelmas. Section 2, off-hand drawing; copying, invention, elevations. Section 1, perspective, continued.

3. From Michaelmas to Christmas. Section 2, outline sketching; geometrical constructions; but for the girls instead, off-hand drawing. Section 1, perspective, further continued.

4. From Christmas to Easter. Section 2, outline sketching; ground-

plans, and in off-hand drawing; copying, invention, elevations. Section 1, perspective, concluded.

*Observations on the foregoing plan.*

1. In the first quarter, Section 2 is so employed that the teacher may busy himself mostly with Section 1, where his aid will be quite indispensable. And in Section 2, also, the exercises, in copying especially, can be adjusted to the capacities of each individual scholar.

2. In the second quarter, Section 2 will have advanced far enough to work by themselves for say half an hour together. That time may thus be spent in introducing Section 2 to the department of drawing elevations. The pleasant summer days will be found quite suitable for drawing in the open air; and the pupils, while unoccupied during vacation, may execute many drawings. Toward the end of this quarter, Section 1 may be set at drawing easy buildings in perspective, in the open air.

3. The third quarter will find Section 2 busily employed with circle and ruler. The pupils of twelve years old, who are going over the ground a second time, will be able to assist those of eleven, so that the teacher will get time to do some open air work in pleasant autumn days with Section 1. But if he does not think it safe to leave Section 2 alone, he may take them out also and let them sketch elevations.

4. When winter comes round again, Section 1 will be employed again in the house, in learning something of drawing bodies bounded by lines not straight. Section 2 will take up off-hand drawing again, in the departments of copying and invention; and some ground-plans may also be drawn.

5. The exercises in copying and invention should continue what was begun in the middle class, but not too rapidly.

For copying, pictures of flowers, fruit, ornaments and characteristic animal forms may be gradually introduced. The inventive drawing may be in part of imagined forms, in part from real objects. No teacher who pursues his subject with a really vivid interest, can fail to find abundance of materials for lessons and models.

2. *Common schools of two classes.*

a. Lower class. If the pupil remains five years in this class, he should draw during the last two. Thus we shall have pupils of eight and nine years of age, in one section; so that each will go twice over the year's course. The course should include all the first half of what was prescribed for the middle class of a school of three classes.

b. Upper class. Here there are many difficulties. I shall sup-



pose two sections to be formed; one of the pupils of ten and eleven, and the other of those of twelve and thirteen, so that each section shall go twice through the course. The lower section should draw what was directed for the upper division of the middle class in a school of three classes. The first division may alternately draw in perspective one hour, and in the next partly make outline sketches and partly work at copying and inventing. There are many disadvantages in this arrangement, but I have not been able to make a better one which was not too intricate; and our pedagogical literature affords very little aid on this subject.

### 3. *Common schools of one class.*

Nothing can here be done in perspective. The pupils should draw, from their tenth year upwards, in two sections. The course of study should be that for the middle class of the school of three classes; except that the children should learn something of outline sketching during the last half year of their schooling. Some of the better scholars may perhaps be permitted to copy some of the exercises laid out for the middle class.

### E. *Miscellaneous Observations.*

1. Beware lest the instruction in drawing educate the children in falsehood. Where every drawing which is shown at an examination is more than half done by the teacher, or by his assistants, such a result is certain to follow.\*

2. The purely technical exercises of off-hand drawing should chiefly be done on the slate; but copying, elevations, finished inventive drawings, &c., on paper. It is necessary to be economical, but then pains should also be taken to enable the children to enjoy repeated examinations of what they have drawn by care and industry. It is always unpleasant to children to see a piece of work which is carefully finished, thrown away at last.

3. Avoid all luxury, especially in poor neighborhoods, in pencils, paper, &c. The children should understand the necessary truth that man must always learn to accomplish the greatest possible results with the simplest means.

4. It is not judicious unsparingly to cross out every ill done work from the pupils drawing book, for this may frequently destroy in a moment the work of many laborious hours, besides disgracing the book, as the children say. Only evident idleness should undergo so severe a punishment.

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\* "Act honestly! Let your examination be a proof, not of what your powers as an artist are, but of what you can do, as a teacher, through the efforts of your pupils. Honor truth: and she will honor thee in turn."—*Hippius*

5. The strictest care should be taken to make the children sit correctly while drawing; for carelessness in this particular will very easily lead to crookedness in weakly children. It is a great evil for the pupil even to turn constantly towards the right hand to look at the design to be copied. A conscientious teacher will use every means of avoiding such habits.

6. The pupils must be protected from too bright sunshine, by curtains or some equivalent means.

7. All conversation should be strictly forbidden during the drawing lesson. It is astonishing to what an extent the looking off from the work which is inseparable from whispering, interferes with and defeats the comprehension of the design and success in reproducing it.

8. The frequent use of India rubber is decidedly to be prevented. This is, in many schools, practiced to a miserable extent; no drawing being finished without having been rubbed out in every part, nobody knows how many times. Instruct the pupil in a truly elementary manner, teach him to apprehend, make him work with attention and care, and away with the India rubber!

9. Whatever work is given to the children to be done at home, must invariably be shown and examined when completed.

10. If possible, let the most skillful pupils be employed as assistants in instruction.



# INSTRUCTION IN SINGING.

BY DR. E. HENTSCHEL.

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## I. DEFINITIONS.

By singing we understand the production of the beautiful, as accomplished by the human voice, by means of the union of musical tones with poetical words; the union of music and poetry.

The elements of speech are sounds; of music, tones. From sounds are formed syllables, words, sentences, periods; from tones, 1, in succession, melodies, which consist of phrases and periods; and 2, in combination, harmonies or chords. Every succession of tones, and of combinations of tones, whether of single tones or those consisting of several tones together, (chords,) may be considered in three respects.

1. Height or lowness, or melodically. This department is called Melody.

2. Length or shortness, or rhythmically. This department is called Rhythm.

3. Loudness or softness, or dynamically. This department is called Dynamics.

The relation of tones to each other with respect to their simultaneous sound, is the harmonic relation; and the study of them is called Harmony.

The distinctions between the various kinds of singing, such as the church, solo, choral, &c., are understood by every one. Either solo or choir singing may be in unison or in harmony. A mixed choir is one in which there are women's or boys' voices as well as men's.

Singing, as a development of the beautiful, is an expression or representation of the feelings. The beautiful is within the singer or subject, as the occasion of his feelings; and it appears also as the object of feelings, through the medium of poetry and music.

Several of the faculties are exerted in singing. The singer is concerned, first, with words. These he must learn (unless in the case where he composes them himself, which is not considered here), remember and reproduce. In learning and understanding the words, their logical and poetical natures are to be considered; and use is made of the understanding, the memory, the imagination, the fancy,

and the sense of beauty. And in reproducing these words, besides the above faculties, the voice is employed.

Secondly, the singer is concerned with musical tones. And these also he must learn, (except in the case, not here considered, where he himself composes them), remember and reproduce. In learning these tones, he must, firstly, consider them with exclusive reference to their melodic, rhythmical, dynamic, and harmonic character, and secondly with reference to their inner or æsthetic character, through which they exemplify the beautiful. The former of these two is accomplished by the musical faculties; the latter, by the fancy and the sense of beauty.

The musical faculties include the musical memory, and the powers of apprehending and of reproducing sounds—usually termed the ear; and also the rhythmical faculty, or faculty of time; as well as that which appreciates the degree of loudness of sounds. The power of apprehending sounds, if developed to the point of intuition of sounds, presupposes a systematic knowledge of sounds, which requires the exercise of the numbering and reckoning faculties, as well as of the memory. In order to the comprehension of tones from the written marks, or notes, which indicate them, is required, besides the musical faculties, a system of notation; which is an affair of the understanding and the memory. And to produce the tones thus indicated, the voice is necessary.

Singing represents feeling; sometimes a feeling which indicates a condition which is not in any proper sense that of the singer, and can perhaps never be so. This is the case for instance, almost always in oratorio, in opera, in ballads and romances, and in singing war-songs, hunting-songs, sea-songs, and many others. But the singing is intended to give pleasure; artistic pleasure; and of this there are different kinds and degrees; the highest being that where the reflective faculties are quiescent, and we are transferred so wholly into a foreign condition of feeling, that we are wholly carried out of ourselves; and every feeling that speaks in the music, whether of grief or joy, becomes entirely our own. This is most easily the case with children, who are always more poetical than adults. Jean Paul says, "Singing imparts to children something of the enjoyment of heaven; for they have not yet lost any of their rights to it."

Men also find in singing an inexhaustible fountain of the noblest pleasure,\* which no one is forbidden to enjoy. The delights of this art are in nowise confined to the saloons of the rich and great; its pleasures and beauties will abide in the most lowly room, under the

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\* "The most joyous of joys, music."—*Klopstock*.



humblest roof, if the occupants only know how to introduce them there.

Singing also produces an artistic transfer of the consciousness, not as it were into a foreign condition of life, but into an excitement of a sort at first strange, but which becomes natural through the influence of the singing. Thus a cheerful song enlivens the sad; a spirited one refreshes the weary; and a devotional one gathers together the thoughts, all distracted by the incessant impulses of outward occupations, and elevates them to God. In such cases as these, there obviously takes place not only a mere transitory pleasure, but often a profound and permanent influence upon the whole inner man.\*

In other circumstances, again, no stimulus, no excitement of the sensibilities is necessary; the heart itself is "full of a thousand feelings," and they overflow in song. A victorious army sings a *Te Deum*; the mournful choir laments the fallen; a rich harvest blessing opens the lips in joyful hymns; friends departing to distant lands mournfully sing a departing song; a Christian congregation joyously shouts its inspiring hosanna to the Lord; an anguished and stricken

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\* A remarkable instance of this nature is related in Schubert's "*History of the Soul*," of the preacher Kühze of Berlin, who was freed, by listening to a devotional song, from an agonizing fear of an apparently necessary operation upon his eye; a result which also had such a favorable influence upon the eye, that the operation was found unnecessary.

"And I can testify," says Luther, "which also experience demonstrates, that after the holy word of God, nothing is so good, and so highly to be praised and famed, as music; and that for the reason that it is a controller of all the movements of the human heart, and has such a power over it, that men are often governed and overcome by it, as by a master."

Acoustics, so far as I know, does not yet account for the fact that we feel pleasure in hearing chords, and displeasure at discords. We know that musical tones are produced by regular atmospheric vibrations, and that all vibrations of aliquot parts chord. If two or more tones sound together, either the atmospheric waves coincide and strengthen each other, or they obstruct and destroy each other. These promotions or obstructions evidently communicate themselves through the ear to the nervous system and the mind, in one case in a manner promoting their natural action, and therefore pleasant; in the other, in a manner obstructing it, and therefore unpleasant. The first of these two kinds of impressions we call a consonance or chord, the latter a dissonance or discord. By the use of both, the artist communicates to us the joy or sorrow of his soul, in an immediate manner; and by the solving of dissonances, which concludes a contest of tones, he communicates that excitement which always follows the conversion of grief into joy.

But more than this, acoustics can not at present tell us. Music has not only scientific but psychological abysses: and no psychologist, even though likewise learned in art, has yet been able to penetrate them. But they exist, because the composer's elevation into pure feeling, into the feeling of the harmony of his own inner nature with the world of sound, exists. "It is," says Prof. Grassmann of Stettin, in his excellent treatise on "*Acoustics*," (Stettin, 1837, p. 25,) "the joyful or sorrowful emotion, which we feel within ourselves in a truly physical and real manner; and again, it is the pulse of our own heart, the deepest longing of our breast, which takes full possession of nature, and is given back again to us through musical tones; so that we may feel ourselves to be no longer individualized, but sunk again within the depths of the universal life. This most secret and profound emotion within us, by a wonderful sympathy, arouses even the least stimulable portions of our nature, and leads us into joy or grief, inso-much that we can hear, sounding back to us, the most secret tremors of the soul; as if nature were calling to us, 'I understand thy profoundest desires; I partake of thy pleasure and thy sorrow.'"



heart cries out of the depths, in lowly penitence. Song is the language of the feelings; and human nature is under a profound necessity to speak in this language. This is proved, not only by the story of "John the Soap-boiler,"\* but by the history of all times and people, and especially by that of Christianity.†

Singing has a great influence upon the life of the feelings. There is truly such a power as the Power of Song.‡ From the battle-songs of the ancient Germans, therefore, down to the patriotic songs of the present day; from the hymns of the early Christian Church to the chorals of Luther, we find it employed for the highest and holiest purposes of our race; not to refer to the analogous place which it filled among the nations of antiquity. It should especially be remembered that it operates, by awakening and stimulating the religious feelings, upon the will, and thus becomes a means of elevating the moral nature. Song is not only a promoter of the Beautiful, but through it of the Good.§

## II. CHARACTER, PURPOSE, IMPORTANCE, AND NECESSITY OF INSTRUCTION IN SINGING.

The character of instruction in singing, is derived from the character of the art itself. As this has for its object to produce the beautiful by means of a union of words and tones, the former has for its object, words, tones, and the union of them. It therefore includes exercises in

1. Understanding and pronouncing words, which comprehends hearing, reading, understanding; or expression.
2. Understanding and producing tones, comprehending melody, rhythm, dynamics, harmony; or, vocal exercises.
3. Conjoining tones and words, which is the union of the two former, in singing, proper; or, execution.

The exercises in words are the same for singing and language.

\* I will quote one similar case from my own experience. In each of the rooms of a school, the class was in the habit of beginning their daily work with a short morning song. The mingling of different tunes and modes sounded ill without; and as circumstances did not permit all the classes to be assembled together for a common morning devotional exercise, it was decided that only one class should sing at a time, each in its turn, a prayer being offered in each of the other rooms. But after a short time all the pupils petitioned for the restoration of the old custom, alleging that it was impossible for them to begin their work without singing.

† "When Christianity had awakened the life of the feelings, and had supplied it with the loftiest ideals of existence, humanity could find only in music a sufficing mode of expression, and thus was gained a new Christian art."—"*Æsthetics of Music*," by Dr. Hand, 1837.

‡ "By the influence which music exerts upon the hearts of all, it operates most powerfully upon the character."—*Kocher's "Music in the Church."*

§ Klopstock said to Rouget de Lisle, author of the "*Marseilles Hymn*," that he was a dangerous man; for that he had killed more than fifty thousand Germans. What then might be said of Körner, Arndt, Schenkendorf, and others? Henry the Lion's motto was



They secure for the pupil a store of imaginations and thoughts; and, as has been observed, they train the understanding, the memory, the fancy, and the æsthetic faculties.

Exercises in tones belong properly to instruction in singing. They give a knowledge of the system of tones, as a separate department of creation, distinguished by an abundance of phenomena; they develop the acoustic faculties, without whose cultivation no education in harmony is possible; and as has been already observed, they train the understanding, the memory, the æsthetic faculties, and the voice.

The exercises in singing, to repeat the observation, have a peculiar influence in enriching and elevating the emotional life, and indirectly upon the determination of the will toward what is good. For it may here be observed, that the sense of beauty, as it becomes developed in any one direction, becomes also, according to the laws of psychology, easier and freer of development in other directions; in this case, namely, in the direction of what is morally beautiful.

Such are the formal and the substantial educational influences of singing. It is likewise in a high degree adapted to assist in leading the child toward what is beautiful, good and true; and to really accomplish this, is its purpose.

It is for this purpose, also, that it is so important for the common schools, which are themselves intended to serve the cause of the beautiful, the good and the true. It may even be said to be absolutely indispensable as a department of common school duty, because it promotes the objects of all the rest, in a manner not otherwise to be supplied.\*

The consideration of some of the special influences of singing as a duty, will only confirm their views of its value. It is an excellent means of sharpening the powers of observation, and of accustoming the pupil to acting promptly as directed by a word, a nod, a look. It thus counteracts both the indolent carelessness and indifference of some, and the precipitate hasty ways of others. In short, it is of great value in a gymnastic and disciplinary point of view.

In most other studies, each single pupil stands by himself and acts for himself; or at least a community of action is not indispensable. But the study of singing puts a close and strict constraint upon all the class together, both in an external and internal sense.†

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\* "Music, by its rhythm and time, imbues the feelings with a regulated harmony. So highly did the Greeks value music, and in so many ways did they practice it, that the expression a "musical man" was equivalent to ours of a "cultivated man." They therefore bestowed the extremest care upon this study, which was designed to unite in a beautiful habitude, readiness, openness, circumspection, and a most powerful mental discipline. "*Pedagogy as a system*," (*Die Pädagogik als System*), by Dr. Karl Rosenkranz. 1843.

† "A choir is like an association of brothers. It opens the heart; and in the streams of song they feel themselves to have but one soul and one heart."—Herder.

And lastly ; it may be observed, that good instruction in singing, by developing the pupil's faculties for rhythm, accent, and melody in speaking, renders very valuable assistance to the increasing efforts at present being made to elevate the style of reading above the repulsive sing-song practiced in so many of the ancient schools.

In concluding this statement of the importance and necessity of teaching singing in the common schools, I may not inappropriately quote the following authoritative opinions :

Music is a means of culture so healthful for sense and soul, so powerfully promotive of virtue and godliness, that we are bound to train our youth in it with conscientiousness and dignity, zeal and perseverance. NAGELI.

Music may be considered a department of man's intellectual life, which he can not omit without restricting and weakening himself. It is one of those intellectual endowments by means of which he is to become conscious of, and joyful in the world, himself, and his mental life. MARR.

Even if the young are unable to attain to any important grade of artistic power, music deserves, on account of its educational value, as possessed of a peculiar power of influencing the mind and the heart, one of the highest places as a department of study. NATORP.

### III. APPLICATION OF THE GENERAL PRINCIPLES OF INSTRUCTION IN SINGING.

#### A. *Two Courses ; their relation.*

The instruction in singing should be both formal (disciplinary) and material (efficient in the study itself.) These two purposes require :

1. A series of elementary exercises ; an elementary course.
2. Practice in singing songs, &c. ; a singing course.

The former is to give the pupil a knowledge of the necessary principles, and a mastery of them ; and the latter, to train him in expression and feeling. We may lay down, therefore, with a view to secure these objects, the following principles :

The elementary course should

1. Continue during the whole period of school attendance.
2. Include all the elementary tones.
3. Proceed by an unbroken progression.

And the singing course should

1. Also last during the whole school period.
2. Be related to the whole life of the child, both within and without the school.
3. Include nothing which is not significant and attractive.

We shall hereafter recur to these principles and add to them. The present purpose is, to inquire what should be the relation of these two courses to each other within the school ?

Should the elementary course precede the other ? In this case, the children would during a certain time have only preparatory exercises, without singing ; and for a long period together ; for the elementary course, to comply with the second and third principles just laid down



respecting it, could not be concluded for weeks and months; which would violate the first principle relating to the singing course, and also the first relative to the elementary course.

We are thus naturally led to the idea of connecting both courses. The most suitable way of accomplishing this, seems to be, to apply in the singing course, the principles learned in the elementary course. This however, sometimes leads to a violation of the principles relating to both courses. It is evidently impossible, for instance, to find songs which shall correspond with all the steps of the long unbroken series of exercises, which shall be satisfactory in point of beauty, and shall bear upon all the various aspects of the child's life.\*

There is therefore no mode left, except to divide what can not be connected; to conduct the singing course independently, parallel with the elementary course. We must be able to sing, at Christmas, "Glory to God in the Highest!" and on the king's birthday, "God save the King," without having to inquire whether in either of them there has not been used some progression or measure which had not been practiced. If some such freedom is not taken, we shall never see the fruits ripen which have been for thirty years looked for from the instruction in singing.

But, it may be asked, How then shall the children be taught to sing? I answer, in that manner which is adapted to the grade of development of their musical powers. Those who can only sing by ear, should sing so; and he who can do more, should do more; whether he can only follow in a general manner the outline of what the notes set before him, or whether he can sing strictly and surely the notes as they stand. The singing course requires the application of all that was learned in the elementary course, but in selecting songs we should not depend entirely upon the former. The pupils should in good season receive the notes, with a brief general explanation. Then each of them should make the best he can of them. Such is both the ancient and modern practice of almost all instructors in singing in chorus, both for small and large classes.

But, it may be further inquired, is not this too mechanical a practice? Does not such a course almost altogether prevent singing with a due feeling of the expression?

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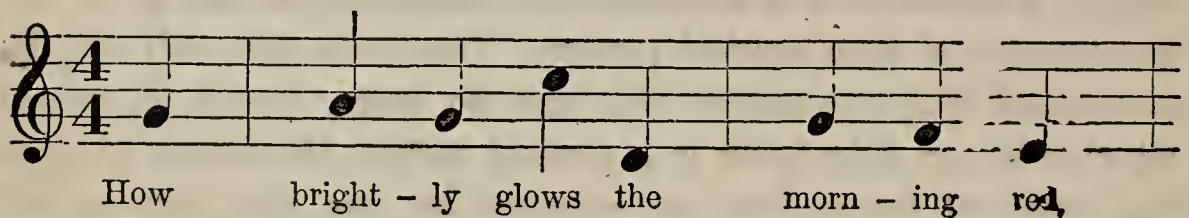
\* At the Martin's Foundation in Erfurt, as appears by the Rhenish "*Gazette*," (*Rheinische Blätter*,) Vol. VI., No. 3, p. 273, all the songs are learned by rote, without notes; that is to say, without any artistic and methodical gradation in their order. It is stated a little further on (p. 286,) that the director of that institution often spends as much as a fortnight in searching and referring, and years in corresponding, to find a suitable song or melody, "because he subordinates the religious instruction entirely to that in singing;" and "rejects all songs which are not good in text and melody, in every particular." I would inquire how long his researches and his correspondence would be, if he should have reference, in addition to anything like systematic progress?

To this I may reply :

The problem which the child must solve in order to sing with proper expression, is usually stated thus : To be able to sing a choral or simple air from the notes without the aid of the teacher. But do you know what is required for this ? This problem, in the first place, is one in which many persons never learn to solve ; because it has not pleased God to endow them with the requisite power of apprehending the tones as written.\* Neither, again, do even remarkably endowed pupils often solve it before their eleventh or twelfth year, however early their instruction is begun, however carefully and skillfully conducted. And only those children solve it at once, who possess very distinguished musical powers ; such who open the whole world of musical sounds to themselves as it were with one magical blow.

And do not be misled if you hear of, or even think you have found, one or another school where the pupils have learned in a very short time to sing from notes or figures. Upon a close examination you will always find one or the other of the following cases true.

Either the airs sung consist of short phrases scarcely including any notes except the first, third, fifth and eighth, and unsatisfactory and crippled, such as the following :



or, the pupils do nothing except to keep time ; that is, they follow after a certain feeling of the succession of the tones, while the teacher, in the pride of his heart, thinks they are reading the notes ; or, some more capable children are acting as choristers to the rest, who sing after them unintelligently, by ear.

But again, what does "mechanical" mean ? Where does it begin,

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\* The result of my observations upon more than a thousand pupils of the most various ages and grades of development, is as follows :

Memory of tones, is universal.

A certain sense of tones, without any clear intuition of tones, is quite frequent.

Comprehension of tone, and certainty in it, quite rare.

And these conclusions are confirmed by the following extract from the "*Rhenish Gazette*," (Vol. X., No. 3,) of an article on instruction in singing, by Karow : "For singing, as well as for music generally, certain natural endowments are necessary, and one destitute of these, whatever his efforts, will not learn to sing. We may compute that, of the singing classes in the schools, the following proportions will be found ; of eighty children, ten will become very skillful and competent singers ; twenty others, not distinguished, but still competent ; five and twenty others, will sing well enough with the rest, but not in solo, as they will depend upon the rest ; twenty others will not trouble themselves with the notes, but will sing only by ear ; and the remaining five will be unable to sing, being defective in ear or voice, or both."



and where does it end? A, sings an air wholly by ear, while B sings it by the notes, by his comprehension of the intervals of the octave. A, it may be said, learns mechanically. B, however, although in a higher grade, also learns mechanically. C, again, who feels the meaning of all the intervals, sings by note accurately without depending merely upon a knowledge of the scale, but does not understand what are the harmonies at the base of the melody:—he also sings mechanically. D, who sings also without depending upon mere knowledge of the scale, knows these harmonies, but not the laws of their connection:—he sings mechanically too. Lastly comes E; whose attainments are equal to theirs and who knows the last item also, but has no idea of the mathematical basis of the system of musical tones;—he is a mechanical singer too! The truth is simply this;—children will, and ought to, and must learn songs all the time; joyous, powerful, living songs. And what can be the harm, if they only sing them by rote, if they can not sing by a knowledge of the scale; or by that knowledge if they have it, if they have not attained to the intuition of the melodic interval? Each one of our faculties is from God, the inferior as well as the higher. Therefore watch over each and make it useful in its own time, and accomplish some good thing with it!

B. *Contents and Management of the two Courses considered, further.*

I. Generally: and

a. Notation. To about the end of the eighth year the children should study without making use of written notes. After that time, however, they should always be used. This delay in using them follows from the principles of proceeding from the simple to the complex, and from the known to the unknown.

It is however necessary both for formal and substantial reasons, that written music be invariably taught. For however little the pupil may know of singing by note, his execution will always be freer in character than if he has learned exclusively by rote. But the very great majority of teachers of singing unite in testifying that under all circumstances, the use of the notes is an important aid in all practice and repetition. And if others maintain from their experience the opposite, and perhaps even say that the notes are a hindrance, they only prove that however interested they may be in singing, they do not know how to use the written notes.

In teaching singing, we should distinguish two principal stages; singing by ear, and singing by note.

The instruction should be by means of actual vision. The representation of sounds by notes is the method most obvious to the eye,

and therefore unconditionally to be preferred. Compare the following two modes of writing an air:

Those exceptionally able pupils who are now and then found in every school, can, according to all experience, sing with equal ease from notes and figures. But it is quite otherwise with all the rest. Whatever may be said to the contrary, they find the notes much the easiest; that is, unless they are drilled in a quantity of unmeaning rhythmic and melodic phrases, instead of real airs, that present a variety of rhythms and intervals. With most children, either the musical faculty gradually develops to the point where they can sing an air with an entire understanding of it, or that degree of attainment is altogether wanting. They are thus, until their fourteenth year, if not permanently, left to practice singing by note, in such a way that they guide themselves, in general, by the form and location of the notes, but where they bring out each single note rather by a sort of feeling of what ought to follow the preceding one, and by means of a knowledge of the scale, than by any real and clear knowledge of melody or the air itself. As long, therefore, as a pupil is not able of himself to execute each note of a written melody, exactly as it ought to sound, so long he has nothing to do with figures, and would get none except utterly indeterminate information from them. But the method by notes always gives him some assistance; it represents to him the relations of the tones, and he has only to look at the notes, to find at least a leading sketch of the melody. And this material representation is of great use in retaining the melody. As the eye seizes upon the groups of notes, the memory connects the tones with them; and it often needs but one glance at the notes to recall whole melodies which have been forgotten. But the figures afford no such assistance. One row of figures looks just like another; and the pupil must go one by one through the whole series, and pick out each note, before he can tell, what the melody is. Therefore, no figures.

The notes should be learned in the key of G, not in that of C, which is in scarcely any collection that most used.

*b.* With respect to singing.

Whatever is learned by children should be learned as thoroughly



as possible; or if that has not been the case, should at once be made so. What is defective neither educates in form nor in substance; and indeed in the former sense it is positively injurious. One third sung too flat brings after it twenty other flat thirds; and passing over one pause endangers the time at every other pause; &c.

In every stage must be unconditionally required purity of intonation, correctness of rhythmic representation, observance of the dynamic marks, clearness of enunciation. Other things must receive a proper relative share of attention.

This perfection in what the children learn must especially be required in three respects; Firstly, the problems, to be solved must always be suitable to the pupil's grade of attainment; the course of instruction must be one of unbroken progression. This principle is universally known and yet often quite disregarded. In many schools, music too difficult is selected for practice; and the unavoidable result is a lamentable disfigurement of musical works perhaps the noblest of their kind. What is the occasion of such errors? Often vanity; often ignorance of music, not always of an excusable kind.

Secondly; the teacher must be competent to give in every case such directions and guidance as are required, in order to avoid what is false, or to remedy it. No pupil can arrange the succession of problems for himself, without the invigorating aid of the teacher. A whole class may perhaps sing an interval too low, and all exhortation to sing it higher may be fruitless, however earnestly they endeavor to do so, because they do not see what the interval is. In such a case the teacher must aid them, by singing or playing the required note correctly.

If the possibility of correctness by the pupil is conceded, then thirdly, the teacher must insist with persevering and unbending strictness, that the problems proposed be solved without error. This proceeding will accustom the pupil to correctness, which will become to him both a musical and a moral necessity. Once more, therefore, endure nothing erroneous! Every thing depends upon this. He is a forlorn teacher enough who permits inaccurate singing for four whole years, with the idea that things will improve in the fifth year, because "people learn to walk by stumbling." That proverb, like many others, is a heap of meal with a cat in it; and he who can not apply it better than that ought to be ashamed. To such I would say: It is *not* by stumbling that people learn to walk; it is by walking.

#### *Rules for practice.*

As important aids toward singing correctly I may name the following:

1. Unless the contrary is strictly prescribed, sing with the full strength of the voice. It is a great fault for the children not to produce a good full tone. A whispering, lisping, powerless melody is never true. But loud singing is not screaming. If the pupils keep strictly to the musical tones they can not scream.

2. In much of the practice, an instrument should be used. Fortunate is the teacher whose school children come every Sunday to church, and standing around the organ, sing the chorals with care and perseverance. That will be worth three singing-lessons a week.

And generally, of elementary singing practice, we may say:

No instrument. Very bad.

Piano-forte. Somewhat better.

Small school-organ. Better again.

Violin. In general, better still.

Church-organ. Very good in some cases.

Sometimes one and sometimes another, according to circumstances.  
Best of all.

The non-use of an instrument occasions such crying evils, that every one must understand them himself. Of the instruments above-named, the piano-forte and organ are better than the violin, for accompanying part-singing; but for exercises in accent, and practicing single voices, the latter is much to be preferred. For while playing the violin, the eye can be kept upon all the children, which is not often the case with keyed instruments in ordinary school-rooms; it can be carried about; and its sharp and piercing tones are much more impressive than those of a piano-forte, or of a small school-organ. The tones, again, can be modified upon the violin, in any desired way, &c.

But let me not be misunderstood. Singing with an accompaniment is not an end, but is the means to an end. A choir accomplishes its proper, real, and most beautiful work, only when singing truly and surely without accompaniment—*a capella*. The same object should be sought in every village school.

3. In singing by beat, the beat should be kept without any break, either by the teacher or by the children, or by both. The teacher should keep time by counting aloud, or by movements of his bow, a rod, &c., each pupil being to go strictly by it. If the children keep time, it should be either by causing some to count aloud while the others sing, or by having all mark time. This they should do, not by using movements like those of the instructor, up, down; up, right, down, &c., but by audible strokes of the hand either on a table or into the other hand; a much easier, more natural, and more useful method.

4. If orthography is the schoolmaster's heaviest cross, enunciation



while singing is certainly one of the second rank. Nothing will avail toward this end, except for the teacher to use zealous and unintermitting strictness with the children—no, first with himself, and afterwards—with himself again, and after that with the children—in the enunciation of everything that is read or sung in the school.\*

II. In particular; and

a. Elementary course. This should include

aa. Exercises in the understanding of the melodic, rhythmic, dynamic, and harmonic relations of tones; exercises in hearing, which, by causing the pupil to note by written marks what he hears, will lead to a knowledge of writing music.

bb. Exercises in singing; in the production of melodic, rhythmic, dynamic, and harmonic tone formations. A distinction should be made between dynamic exercises and vocal exercises proper, in the strict sense; such as are intended to operate upon the material of the voice, and to give it strength, endurance, sweetness, flexibility, and quickness. Nor can the harmonic exercises be properly referred to those in melody. In order to avoid confusion, the following compendious classification will be found convenient: 1. Melodic exercises, including those in harmony. 2. Rhythm. 3. Exercises for the voice, including dynamics.

To proceed to the necessary directions as to the arrangement and conduct of these departments of practice.

1. It has already been stated that the elementary course should extend through the whole school period, its easiest exercises may be commenced with children of five or six years old. For the rest, "Art is long, and school time short." There are many things which must be studied only by advanced scholars, such for instance as the minor key, &c.

2. The elementary course, as has also been observed, should include all the elements, and therefore the harmonic. Harmony, even in its elements, is of especial value for formal training; and is also very attractive to pupils. It opens to them an entirely new view of music.

3. The principle already laid down, that the elementary exercises should proceed without any intermission, is a universal one; but in singing it is of especial importance, which is the reason why it is repeated here.

4. The matter should be arranged at once subjectively and objec-

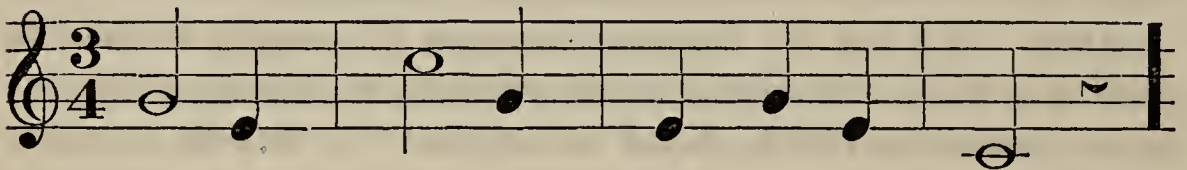
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\* There was a little girl who, in a song to Spring which she had learned in school, sang "A Moor out of his shell, springs out the tender shoot," (*Ein Mohr, &c.*) instead of "Upwards out of, &c.," (*Empor, &c.*) and when told that the latter was the correct word, she answered that her teacher knew best about that.

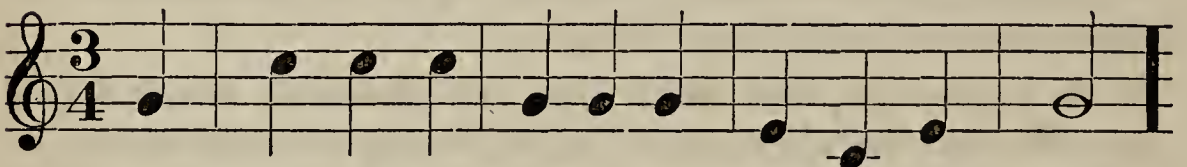
Again; a boy was asked what they sung in school, and said, "The Chandelier," (*Der Kronleuchter*;) having caught that sound instead of the word "Scale," (*Tonleiter*.)

tively. To arrange it wholly objectively is unpedagogical; wholly subjectively, impossible. It is not correct to pursue one department through, as rhythm for instance, and then melody, but they should be taken in corresponding portions; first the easiest parts of all the departments, so far as they belong to the matter in hand, then the more difficult ones, and so on. But this subdivision must not be carried too far, for fear of losing the connection of what is taught.

5. The different departments should be so taught that some one of them shall always be the main subject, and yet so that from one step to another they shall always form a whole. The former of these requisites follows from the principle of taking simple things before complex; the latter will enliven the children, and render the teaching substantial and significant. If, for instance, the time be  $\frac{3}{4}$ , and the melody that of the major common chord of the first, there may result forms like this,



And words may be set to such phrases; as, for instance,



Rise up from your pil-low, for cock-crow is past!

The smaller the attainments of the pupils, the more care is necessary to preserve them from what is unmusical and unpoetical. As they proceed further, it is of course easier and easier to select not only brief musical phrases, but entire songs, which can be used first for illustration, and then in the singing course. But care must be taken that the songs do not become the principal thing, and the practice of the elements secondary.

The rule that only one department is to be the object of study at a time, must not be construed to mean that no time should be kept while studying melody, and that the rhythmic exercises should be in monotone. So complete a disjunction as this of the elements of music, neither accords with the nature of music nor with that of the child. We often find rhythm without melody it is true, as in the drum; but melody will not accept the converse, and go without its companion and supporter, rhythm. Even the simplest exercises very soon become wearisome and distasteful if they include no rhythm.



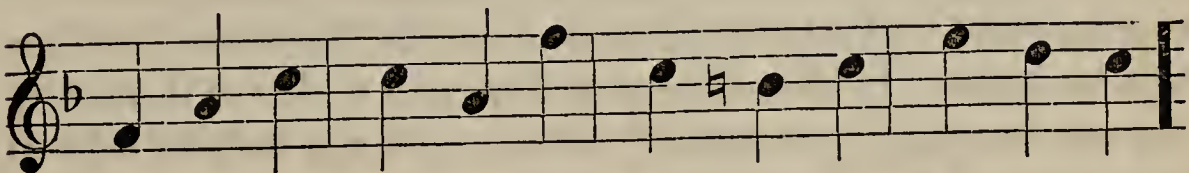
The children's minds develop all parts together; and therefore the melodic exercises should have some rhythmic forms, and the rhythmic ones some melodic form.

6. The course of proceeding should be from things to their names and signs. When, for instance, the children are to go from quarter notes to eighth notes, some quarter notes should first be played, while the children beat in four-four time; then a sudden transition should be made to eighth notes, which will strike the attention of the children, after which the name of the shorter note may be told them, and its representation shown.

7. Even during the stage of singing by ear, melodic and rhythmic voice-exercises should be given.

8. The harmonic element should be as much as possible omitted from the melodic exercises at this stage. It should only be introduced so far as is necessary to understand and correctly sing the major common chord in its simplest forms.

9. The vocal exercises of this period should be arranged with very great care to limit them to the capacities of the age of the children. They should, in general, consist of very easy successions of quarter notes of moderate pitch, sung sometimes loudly and sometimes softly; such, for instance, as these:



10. The harmonic element is most appropriately brought out in connection with the scale. It is true that very little work can be done with it, but that is no reason why none should be done. The following points may be taught:

*aa.* Construction of common chords or triads upon the first, fifth and fourth of the key.

*bb.* Construction of the chord of the seventh on the fifth of the key.

*cc.* Establishment of the following as the fundamental musical chords:

I.	V.	I.		
I.	IV.	I.		
I.	IV.	I.	V.	I.
I.	V.	I.	IV.	I.
I.	IV.	V.	I.	

It will be of course understood that these principles must be brought out by means of actual intuition. Mere words and figures would be

entirely useless. The children must hear the chords and their successions. For this purpose the school organ\* will be found very useful, but not indispensable, for the teacher will have a living organ; namely, the children themselves.

11. Vocal exercises in the scale—with rather more advanced children therefore—should be made a chief study here.

The best material for this practice is the scale itself, which should be sung in long, sustained, *crescendo* and *diminuendo* tones. The common schools have nothing to do with artistic runs, trills, &c. Instrumental accompaniment is especially necessary here.

The middle notes of the voice should be chiefly practiced, and in the scales of D, E♭, E, and F. The children should never be required to force out very high notes by a violent effort, which proceeding can only do harm. And it is as unfair as it is ill-calculated, to endeavor to train the children to a more correct style of singing by making them sing every air a third or a fourth higher than it was set by the composer.

12. The pupils should be trained to write upon the staff the notes which they hear. Diligent practice in writing music should therefore be required. Otherwise the pupils' attainments will be entirely one-sided. To sing from note is one thing; but it is another, and equally important for musical culture, to be able to write down notes that are heard. Writing music also constrains that class of scholars who are disposed to accommodate their singing to that of the rest, to the exertion of all their musical faculties. And it is the only mode of continuing the instruction after the children have arrived at the point of intuitional comprehension of the music, and of preserving them from innumerable errors. If Nägeli had done nothing except to introduce writing music as an exercise into the schools, he would even then have done them an exceedingly great service.

#### b. Singing Course.

I shall repeat here the three laws already laid down, and shall add others.

1. The singing course should continue through the whole school period. Even the youngest pupils will readily sing simple airs by ear; and according to all experience will partake of their enlivening and improving effects.

2. The singing should have a real reference to the life of the child.†

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\* The melodeon, perhaps, in an American school.—*Trans.*

† "The simplest enjoyment and the simplest instruction, are enlivened and reinforced by singing; and what we even fail to accomplish by instruction in faith and morals, may be taught by song."—*Goethe, Wilhelm Meister's Wander-Years.*

At the Rauhe Haus near Hamburg, great stress is laid upon singing. Credible reporters.



Singing is intended to enliven, ennoble, and cheer the whole of man's life. Regard should be had to the present and the future of the child; to his permanent and varying relations to nature, other men, and God. With reference to the present condition of the children, instruction in singing should, above all things, stand in the closest connection with religious instruction; including the faith, love, and hope of Christians. And on every occasion of school life when the religious feelings of the pupils are appealed to, at the beginning and end of lessons, weeks, months, or years, at preparation for a church festival, at confirmation, the king's birthday, &c., singing should be employed. In our day, the liturgical element, in which singing holds an important place, has been introduced for religious purposes into schools. This is much to be rejoiced at; and may be of very great service.

There should be a little singing festival in the church at least once a month; and not merely on such occasions as visitations, consecrating an organ, &c. This might be done without difficulty almost every where. But it will be necessary to confine the selections to the simplest class of music, and to persevere in accustoming the congregation by little and little to take more pleasure in such music, than in the ungodly uproar of the usual style of church music. Materials truly useful should be selected, every thing should be thoroughly practiced, and care should be taken that the audience may understand the words.

Besides religious songs, secular ones should also be learned, so that the children may use them as a means of enjoying themselves at home, at play, at festivals, during walks, journeys, &c. And for this purpose, such music is appropriate as has the artistic effect of transporting the child into conditions of existence quite strange to him.

How shall reference be had, in the school singing, to the future of the scholars?

First, by having a good stock of chorals.\* Chorals are an indispensable necessity of religion and sacred worship. Every child should be able at leaving school, to sing at least fifty or sixty chorals from memory.

There should also be a suitable number of secular songs. With proper management, the pupil may graduate in possession of as many as thirty such. What should their subjects be? Experience shows that the religious feelings of the people expresses itself through the medium of chorals. For this reason I should use songs for other

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describe the judicious mode in which Mr. Wichern makes use of it at prayer and labor, exhortation and admonition, at serious and cheerful occasions. and sorrow and joy, and of the important good which he thus accomplishes.

\* These correspond to our usual church psalmody.--*Trans.*

purposes. Of them, also, I should exclude some kinds, viz: 1. All songs of particular vocations, except war-songs, and for their proper localities, mountain songs and sea-songs. 2. Songs for occasions that rarely happen in actual life; such as, "Up! with mountain-staff in hand, forth with joy to Switzerland;" which is nevertheless in itself a good song. 3. All songs which, though perhaps good in themselves, do not correspond with the popular mode of thought and feeling; such as, "Know'st thou the land where the lemon-trees bloom?" 4. Love songs. 5. Drinking songs. I add a mere suggestion of the proportion in which I would perhaps arrange thirty songs to be learned, namely: five, to incite to good company; three soldier's songs; three traveling songs; six for general expressions of pleasure, and for observation of nature; four patriotic; five romantic historical; four miscellaneous. Total, thirty. For girls, I would substitute cradle songs for the soldiers' songs, and for the traveling songs, others referring to the observation of nature.

3. All songs should be beautiful, both poetically and musically.

What is worthless in itself can never develop the artistic sense, nor properly cultivate the feelings. There are good words to bad tunes, and wretched rhymes to beautiful tunes. And it requires much study on the part of the teacher to acquire a sure judgment on this subject.\* Especial care is needed with respect to children's songs, properly so called; for among the great number of them are many bad ones. A children's song is never good unless it can be sung with some enjoyment by grown persons also. Moralizing songs for children, in particular, are bad, and always will be; and so are those where the children are made to sing to each other, and encourage each other to joy, to innocent cheerfulness, &c.; such as,

"Open brothers, ear and heart,  
Unto teachings wise."

"Our daily work is done at length:  
Now for a joyous game!  
Pleasure for working gives us strength,  
And strengthens all the frame."

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\* "Notwithstanding the great number of songs for the young, yet but very few of them are really adapted for use; partly on account of their faulty and spiritless melodies, and partly, and especially, on account of unsuitable words. \* \* \* \* The text of a song must be adapted to the young, clear and plain, joyous and vivid; equally removed from watery and feeble sentimentality, and from a stupid jumble of morals and phrases."—*Memorial of the Nuremberg Education Society.*

As music is variously taught and practiced in the teachers' seminaries, many young teachers come to believe that it is an easy thing to compose for singing. So they proceed with great confidence to make motets, and hymns and cantatas, and make all possible haste to introduce their compositions into a church or a school. Great evils are to be apprehended from this source.



Some valuable observations upon this pseudo-poetry are to be found in Franz Horn's "*For-te-piano*," and Hiecke's "*Instruction in German in the German gymnasia*" (*Der deutsche Unterricht auf deutschen Gymnasien.*)

With regard to the relation between the words and music, we can not be too mistrustful, in particular, of operatic airs with words set to them.\*

Songs, to be appropriate, must be both objectively beautiful, in themselves considered, and suited to the children's capacity. Children should not be forced up to any thing which is without the sphere of their apprehensions. On this point, I shall hereafter remark further.

4. Each style of songs should be used for its proper purpose; for each has its peculiar influence in training the pupil.

a. Sufficient reasons have already been given for cultivating both church and secular singing in schools, it may be added, that the former can not properly be very extensively used in the lower classes, and must commonly be sung somewhat faster than at subsequent periods.

b. Care should be taken to have the singing in unison, or in parts, as the case may demand either. Children less than nine years old, usually sing in unison. Part singing is not natural to them, whatever credit it would obtain at examinations. With older children the case is different; they may sing in parts; but should still not transgress the limits of popular requisites in the artistic direction. Part-singing is however so efficient a means of artistic training, and its power over the feelings is so great, that it should not be omitted, even in the smallest school.

On this important subject many mistakes are made. The following principles may serve the reader as initial points for his belief.

aa. A mixed choir is always most efficient; and should therefore be formed wherever possible. The school will furnish sopranos and altos; and there can always be found some accommodating youths or men, who will sing tenor and bass. The thing can easily enough be done without sounding drums and trumpets, with prudence and perseverance.

The societies for men's choirs seem in some places and lately to have hindered the prosperity of small mixed choirs. This is much to be regretted, however useful those societies are. Forget not the children!

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\* In an extensively used collection of songs, the "Hunter's Chorus in the Freyschutz," is to be found, set to an Advent hymn! In the same, "Christ a gardener," is set to the duett from Titus, "In friendship's arms;" which, as a reviewer in the "*South German Messenger*," (*Suddeutscher Boten*.) says, "fits like a theatrical costume on a clergyman."

*bb.* In schools where only the children can be employed, the following plan may be adopted, which will prevent very various errors, namely: The children should sing chorals, generally, in unison; secular songs in two parts; and all music for religious, and especially church festivities, in three parts.

Chorals can not and should not be sung in parts, for the reason that time will not be found for practicing them in that manner; and because it would prevent those appointed for the middle and lower parts, from thoroughly learning the air—a great disadvantage.

Only on some few special occasions should a choral be sung by the children in three parts; and if such an experiment should succeed, it would probably be beneficial.

Chorals in two parts are always somewhat dry. But if the teacher will have some such, let him be careful to see that the second part is of an independent and marked character.

The reasons for singing secular songs in two parts are these:—

1. This method is indicated by the nature of that sort of music.
2. The practice will be found sufficient for the needs of the children in that particular.

3. It does not, like singing in three parts, impose on some of the children the necessity of sacrificing themselves for the sake of the rest, by the unnatural practice of singing in the lower register, which is also in itself uninteresting to them, and if long continued, very wearing.\* But the church requires a more dignified style. Here, singing in two parts seems empty and dry; at least three parts are necessary. Nor should the choruses in the liturgy be sung in two parts only; but rather in unison, with organ accompaniment. Children can profitably sing in four parts only under very favorable circumstances.†

*c.* Solo singing, as well as singing in choir, must also be attended to. This is necessary both on account of the individual development of the pupil as well as the formation of his style, and the consequent influence of it on the feelings. With regard to this last point, I need only refer to such songs, motets, and little choruses, as are used in school in which choruses and solos alternate. The effect of such pieces when well executed, is very good. It also has a very good effect, when some single verse of a song is sung by some one person, the whole singing the next. The solo singers should be trained separately, by which however I do not mean that they should be trained in the higher artistic departments of music.

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\* Gersbach, Herder, Rinck, Mühlney, B. Klein, and the profound Nägeli, have, I believe, scarcely set any children's songs in more than two parts. Their statements of the reasons, however, are not sufficiently lucid.

† There are very various opinions on this point, and I know that many persons differ from me. But I have many authorities on my side.



5. Care should be taken, not only to select music suitable to the children's capacity, but to practice them long enough to be able to execute them with certainty and freedom.

This principle has already been indicated in substance, but ought to be here again stated in full and expressly.\* It is not until all technicalities are done away with, and all sense of constraint or impediment by difficulties is removed, that the heart of the singer opens itself. The desperate efforts of some singers, or entire choirs, to accomplish a task beyond their abilities, does not even afford the audience the pleasure derived from the breakneck leaps of a rope-dancer. Therefore, no great contrapuntistic choruses, nor elaborate solos. All that is required is simple songs, and little motets and choruses, at the utmost not more difficult than the most difficult of Hientzsch and Erk. If circumstances imperatively require that the children should execute some more elaborate piece of church music, the most skillful of them should be selected, and practiced in private on the cantatas, hymns, &c.

6. The practicing of songs, during the period of singing by ear, should be by playing or singing them over to the children, who should then endeavor to execute them.

When the period of singing from note begins, some ten or twelve lessons will probably be needed to acquaint the children with the main points as to the meaning of the notes, especially their rhythmical value; which should be thoroughly illustrated by examples. Then will follow the use of the notes in practicing songs. The children should be prevented from becoming discouraged if they do not at first understand more than a very little of the details of the system of notes. They should be allowed to be astonished, not at what the notes do not do for them, but on the other hand as the real help which they afford. And they will be much delighted, as the meaning of the written notes, at first so puzzling, becomes gradually more and more distinct, and when at last the song which is given them to sing shall contain its own explanation.

#### C. INSTRUCTION IN SINGING, IN COMMON SCHOOLS OF THREE CLASSES.†

(Two hours of singing in each class, weekly.)

1. *Lower Class*.—(Four half hours.) In each half hour; Elementary Exercises, ten minutes; Songs, twenty minutes.

2. *Middle Class*.—(Two full hours.) *First*: Indispensable information as to the notes, and for practicing songs; together with repetition of songs previously learned. This during from four to six weeks.

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\* "In order that the execution of compositions may be as little as possible interrupted or hindered by ignorance or hesitation, and that no perplexity may interfere with the artistic conceptions of the singer, and thus prevent the successful training of his feelings."—Nägeli.

† Viz., of a three years' course.

*Next*, in each hour ; Vocal Exercises, ten minutes ; other Elementary Exercises, twenty minutes ; Songs, thirty minutes.

3. *Upper Class*.—(Two full hours.) *First* : Continuation of the fundamentals of written music, and repetition of songs already learned. This during three or four weeks.

*Then*, during each hour ; Vocal Exercises, ten minutes ; other Elementary Exercises, twenty minutes ; Songs thirty minutes.

*Details on the above points.*

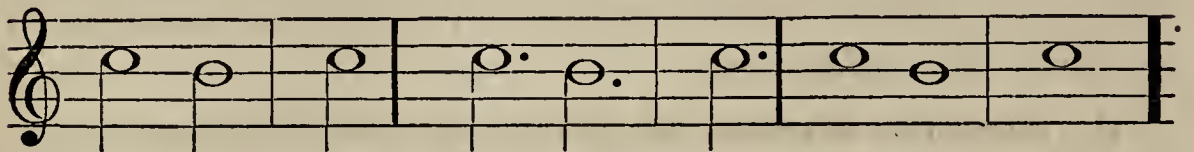
a. Lower class.

The elementary course consists of simple exercises, in the singing by rote of single tones and simple connected tones ; in distinguishing high and low, long and short, loud and soft tones, in counting to time, &c. ; such as are prescribed in almost all the better class of books on the subject. A course of vocal exercises should also be combined with this.

Take for example the following cadence.



The teacher plays these notes, the children counting them. Then let them describe them, somewhat thus ; “The second tone was lower than the first, and the third higher than the second ; and the third was like the first.” Then let them sing them, to the sound *ah*, first getting the measure of their duration from the playing of the teacher ; who must by the way watch carefully to see that the last note is not flat. Then let them count to each tone, one, two, and one, two, three, and one, two, three, four, while the teacher is playing them ; and let them also beat time. And then let them do the same to their own singing of the notes. In these cases, they will sing the following.

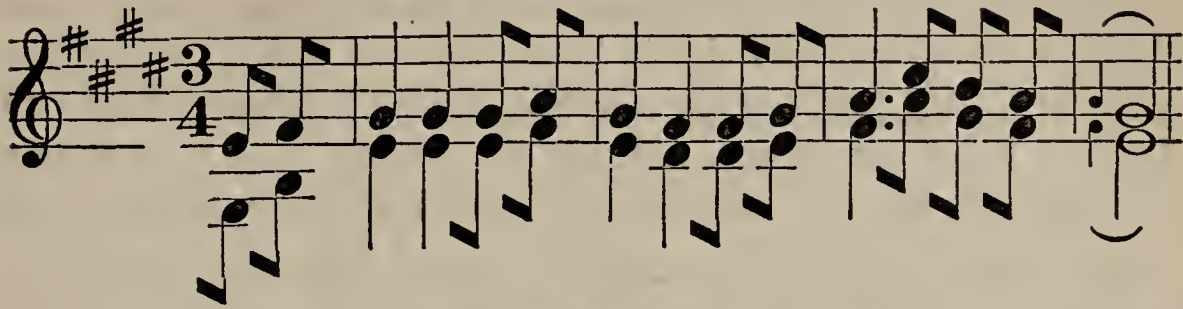


Then let them sing the same notes to words, such as “summer comes,” or the like ; which will give an opportunity to train them in enunciation. That is, they must say, not “sum-mer,” dwelling on the *m* with their mouths shut, but su-mmer, holding the vowel sound, &c. Lastly, the cadence may have a name given to it ; it is a “cadence from below.” Such exercises will be found very interesting, if conducted with spirit.

The songs, in the lower class, must be sung by ear, after being



played or sung by the teacher. The following may serve as an example :



Oh how cold the weather's growing, And the sky all cloud-ed o'er.



From the North fierce winds are blowing, And the sun-shine's seen no more.

First the words should be repeated to the class, and said over by them. Any mispronunciations should be corrected; and the words "o'er," "north," "fierce," &c., briefly explained. The teacher then announces that he will play the melody. All are attentive. He plays the first half of it, once, twice, thrice, four times; the children beating time, which they can easily do. Some of them will at once begin to hum over the air, but should be stopped. The fifth time, they may all sing it, softly. Then the teacher sings it alone, then plays it alone; and then the children sing it by themselves, the teacher marking time for them. Perhaps they will sing the second or third G too low, or fall behind the time, or take breath after "cold," or make the first note of the third full measure too short, &c.; all of which errors should be corrected on the spot. For a change, sometimes part of the class may sing, and sometimes all; and perhaps some one of them may be found bold enough and able enough to sing in solo. The teacher should always accompany, to prevent falling from the pitch. After the first half of the melody has been learned, the second should be practiced in the same way. When the whole is well committed, the teacher may play second to the children's soprano, or sing a second, and play the first. It will not sound well for him to sing the air. Then the remaining stanzas of the song may be learned. Every thing should be executed correctly and well. The result of such a course of training will be very satisfactory. When the children go home, they will be singing the song, wherever they are. What more could be desired?

b. Middle class.

As has been stated, this class should begin by devoting from four to six weeks to a very simple preparation for singing by note. The object of this preparation should be to make the children acquainted with the leading points of the notation, without burdening them with details. It can not be expected that the children shall learn to sing independently by note; but they will receive whatever assistance the notes can give them; their eyes, ears, and feeling for time, will be trained. An excessively long step will be avoided, by thus placing the children midway of the great space between singing without notes, and the free reproduction of what the notes represent. They will attain to the position occupied by those many thousand singers who do not indeed really sing by note, but who still would not on any account be without the notes. In short, the pupils will be placed in a situation where they will learn songs, not with a full intuitional appreciation, but with the aid of the use of their faculties of tune and time.

What should be the exact importance of these acquirements? I think it should be sufficient, if the children learn that

1. The tones, rise, or fall, as the notes do.
2. The notes show whether the tones proceed onward by gradations or jumps.
3. The steps of the latter kind are various; thirds, fourths, fifths, sixths, sevenths, octaves. The pupils must learn to recognize these promptly by the notes. A short series of exercises should be given to acquire this facility, preparations having been already made for it in the lower class; by playing one and another of these intervals in different parts of the major scale, and making the children what they are; and then by the reverse method of calling for an interval, which the children are to sing. But nothing difficult should be introduced.
4. The notes indicate the length of the tones.
5. There are whole, half, fourth, eighth and sixteenth notes. A whole one is as long as two half ones, a half as two fourths, &c.
6. There are also rests or pauses, fourth rests, eighth rests, &c.
7. A note or a rest very often has a point or dot with it; which increases its length one half.
8. The notes are arranged into groups or sections, each of which is called a measure. One measure may contain four quarter notes, or three, or two; or three eighth notes, or six, &c. The pupils must be able to name all these.
9. They must also be able to beat time. For  $\frac{4}{4}$  time, four motions of the hand must be made, for  $\frac{3}{4}$  three, for  $\frac{2}{4}$  two, for  $\frac{3}{8}$  three, for  $\frac{6}{8}$  six, or sometimes two. It will be a sufficient exercise to them, if ap-



propriate portions of airs are written on the blackboard, named, and then played, while the children keep time, counting aloud.

10. Various marks are used to indicate whether to sing loudly, moderately, or softly.

11. The words are printed underneath, one syllable to each note; if several notes are connected together by a stroke or a curved line, they are all to be sung to one syllable.

12. There are many other marks, which will be learned afterward. The present is only a small beginning.

To know the names of the notes will be of no use to the children in this stage, because the present object is not an introduction to the system of the tones, but merely to afford the means of gathering by the eye an acquaintance with the outlines of a melody.

About midsummer, if the course commenced about Easter, the children can continue their singing practice in the green and flowery meadows; where they may wander without being constrained by methodical hedges and ditches, walls and timbers; freely, joyously, and, if God will, piously.

*Rules for singing practice.*

1. Whatever is to be understood must, so far as the children's capacity will go, be made entirely clear to them, and then stated by them.

2. In general, the children should be encouraged to make exertions of themselves; and they should be encouraged—especially those who are in their second year—to endeavor frequently to sing the air which is in hand, without assistance. But this must be done cheerfully and with interest; without any misery or any inflictions.

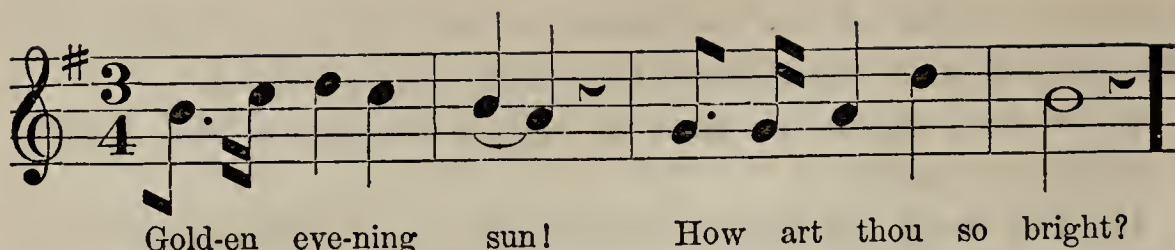
3. Where the children's knowledge fails them, play them the air.

4. Part of them—to repeat the suggestion once more—only count time aloud, while the others sing. But all of them must always keep time by light blows on the other hand or on the table, until the music is learned with entire certainty.

5. Every eye should be strictly required to be directed to the music. The less capable may often be assisted by pointing out one note after another with a stick.

Close adherence to these fourth and fifth rules will often give the children a facility in singing by note beyond what could have been believed.

An example will illustrate this course of proceeding. I select the beginning of a well-known song by Nägeli:—



Let the notes be very plainly written on the blackboard, at first without the words. Then let the notes be first read, thus: "Dotted eighth; sixteenth, rising second; fourth, rising second; fourth, falling second, &c., &c.;" ending with "fourth, rising fourth; half, falling third."\* Then a rising fourth and a falling third may be sung. The children can sing these intervals themselves, with occasional assistance, if their ear has been sufficiently well trained. That is, if they remember clearly the triad g, b, d, they will not sing g, b, instead of g, d. Then those who are in their second or third year's practice may sing the scale with *la*, except a few who are to be stationed with the smaller children, to count aloud, keeping time, also, with blows on the hand or the table. If the air is correctly sung, well; if not, let it be played over by the teacher. Then the smaller children may sing along with the rest, another section counting; or all may beat time. This exercise should continue until the melody is sung with entire correctness and in strict time. Then the text may be written under the music.

This practice is for the last half of the singing lesson. The first half should be used for the elementary course. My mode in this particular would be the following: Take one of the better works on teaching singing, and begin where the subject of written notes is introduced, and proceed strictly as is written, going very slowly, since there is time enough; and be satisfied with whatever acquirements can be made. Only, some portions of the songs given as exercises in time or melody may perhaps be omitted, if the purpose of comprehending the written tones is attained; since the singing-course has particular reference to the development of the feelings of the children.

This should usually be opened by vocal exercises; which are also often properly introduced just before or during the singing exercises. Our practice (at Weissenfels) is to practice the scale, at first in two

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\* This mensuration of the intervals is of the greatest importance; at least, my own experience shows that for the majority of pupils it is the simplest and surest way of learning to sing truly. It is an excellent thing when a pupil feels the key so well as to be able to strike the intervals correctly by taking the notes in their relation to the key note. But this power will fail him as soon as the melody passes a little beyond the limits of the simplest juvenile songs, and even within those limits will be much confused by a modulation. In these cases, if the pupil is not practiced in the sort of knowledge of the intervals referred to in the text, he will grope about in an uncertain manner, as is the case with too many who sing by figures.



tetrachords (c, d, e, f; and g, a, b, c:) then altogether, usually with the sound a, b, sometimes loudly and sometimes softly, (the latter is much the most difficult, but is very important;) and always beating time (with two, three, four or six beats to a note.)

Thus the pupil makes his way through the middle class. At his leaving it, his voice will be found somewhat developed, a fund of songs laid up in his memory, and his power of reading at sight gratifyingly cultivated. The latter however is very seldom the case to an extent that makes it allowable to dispense with carrying on the elementary course together with the singing course, in the higher class. Careful beating time must also still be kept up for a long period yet; it is only in the latter years of their school life that the more capable of the children will be found capable of singing independently by note.

c. Upper class.

Before proceeding here with the singing course, the pupils must be somewhat further practiced in written music, for the sake of easier understanding. From three to four weeks at the beginning of the course may be specially devoted to this purpose. However much progress may have been made in the middle class, or the elementary course, they must yet be taught in the upper class:—

1. That there is a universal (chromatic) scale which is several times repeated.
2. That it consists of twelve tones.
3. That the tones are so near together that it would not be easy to sing another between them.
4. That the steps from one of these tones to the other is called a half tone or semitone.
5. That these tones have their fixed names and signs; and what these are. The scale most natural to commence with will be that of C, the intermediate tones being added. The nature of these semitones may be illustrated by marks, by a scale, a staircase, the keys of the piano-forte, the situation of the tones on the neck of the violin, and by playing and singing them over.

Reading written music, to which the middle class has at least afforded an introduction, must here become an indispensable preliminary to singing practice. The subject of the different keys can not be begun in these three weeks of instruction; it must be left for the elementary course, to be there treated deliberately and thoroughly.

About Whitsunday, of the third year, again, singing practice may recommence, the vocal exercises being resumed, and the elementary course taken up again where it was left off in the middle class.

I may properly give an instance of the instruction in singing of the upper class; for which I will select a Whitsunday hymn.

Deck the walls with wreaths of flowers, And conse - crate to God the

hours, And let the al - tar al - so bloom.

The course of instruction may be as follows:—1. The key, signature and time may be determined. 2. Count the measures. 3. Read the notes, as follows, a; a; rising fourth, d; rising third, f sharp; falling second, e; falling second, d; rising second, e; rising second, f sharp; falling third, d, &c. 4. Take up the longer intervals. Which are the thirds? The fourths? Who can sing a fourth? How does a sixth sound? &c. 5. The upper section makes an attempt to sing the scale with la, the lower section beating time and counting aloud. Every eye fixed on the notes! Trifling variations from the melody can easily be corrected with the violin; if there are any serious ones, the class must be stopped, and the error expressly corrected. If they do not succeed after two or three attempts, play the passage to them.

6. All the class sings the scale, naming the notes by name, and beating time accurately.

7. The words are put under the music.

When afterward the keys are discussed, they can be properly spoken of at each lesson. The principal thing, however continues to be that the children shall recognize the intervals, even if only by their numeral designation, and not by the interval of sound. Experience teaches that those who learn on that plan gain a very good degree of certainty and facility. It will of course be observed that as the elementary course progresses, the increasing vocalizing powers of the class can be more and more exercised.

I could now proceed, if my space would permit, to describe in very bright colors our scholar, now stepping forth from the upper class into active life, free, joyous, bold, and if God please, pious. But I leave every young teacher to imagine such a picture for himself.



## NEW CHEMICAL LABORATORIES IN PRUSSIA.

The establishment of two great chemical laboratories in connection with the two otherwise best equipped universities of Prussia, on a scale and with an expenditure unprecedented, not only in that, but in any country, is a recognition of the position which chemistry now occupies in reference both to scientific inquiry, and to the industrial arts. The following account is abridged from a Report\* to the English Department of Science and Art, by Dr. Hoffman, under whose direction the laboratory of the School of Chemistry in London, now attached to the School of Mines, was constructed. The example of Prussia has already attracted the attention of the Russian, English, and French governments; and the Minister of Public Instruction in France has already obtained the necessary pecuniary means to enlarge and reorganize the laboratories of the Museum of Natural History, the School of Medicine, and the Superior Normal School, and to establish in Paris, others, larger and more complete, designating them "the arsenals in which are to be forged the weapons for new conquests in the field of experimental science and industrial development."

## I BONN.

The first negotiations respecting the building of a new laboratory in Bonn commenced in 1861. Situated on the high road of Europe, on the banks of the mighty Rhine, surrounded by some of the most charming scenery of the world, distant but a few hours from the Belgium frontier, and scarcely farther removed from France, within reach of England by a short day's journey, in the midst of a large agricultural, vine-growing, and mining populations, in close proximity with the great manufacturing districts of Rhineland and Westphalia, united with the focus of this large industrial territory by a network of railways whose meshes are augmenting daily, itself the seat of one of the most flourishing universities and schools of agriculture in Germany,—the city of Bonn embodied a number of conditions which cannot fail to secure the rapid success of a large chemical institution established within its walls.

The scientific arrangements of the building were entrusted to Professor A. W. Hoffman, after a careful study of the latest structures of the kind in Europe. The foundation was laid in the spring of 1865, and the construction has gone on under the direct superintendence of an able young architect, Mr. Jacob Neumann, and the building, properly equipped, was handed over to the university in the summer of 1868.

Of the several institutions in the Rhenish university, part only are situated in the electoral castle in Bonn, granted to the university at its foundation in the year 1818; others, for instance, the natural history collections, the magnificent and world-renowned astronomical observatory, the botanic gardens, the agricultural academy, are located in the village of Poppelsdorf, about fifteen minutes' walk from the castle, but connected with it by one of the finest chestnut avenues in Germany. In close proximity to the castle of Poppelsdorf, a tract of land, the freehold property of the university, was chosen for the site of the new laboratory, and a more favorable situation could scarcely have been found.

The land allotted by the university is of very considerable extent. The spacious building, covering, with its four enclosed courts, an area of 45,000 square

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\*Report of Dr. Hoffman to the Department of Science and Art, of the Committee of Council on Education, London.

feet, is surrounded by a handsome garden, which at the back extends to some depth, leaving ample room for the erection of any accessory buildings that may be required at some later time. Thus unfettered by narrowness of space, or the fear of having air or light shut out by the close proximity of other buildings, and on a well drained soil, the architect was enabled to lay out the plan of the edifice with a degree of freedom that has materially promoted the beauty and harmony of his work.

Even the slight distance from the city of Bonn might appear at first sight a disadvantage. Since, however, the natural science institutions of the university, almost without exception, are concentrated at Poppelsdorf, it is a real convenience to the students that the chemical laboratory is in their neighborhood, besides being removed from the annoyances of a rapidly growing town, and commanding views of unsurpassed beauty; on one side, the chestnut avenues and the city of Bonn with the lofty spire of its cathedral; on the other side, the castle, with the adjacent botanic gardens; in the distance, the Kreuzberg, with its chapel; and farther still, on the opposite bank of the Rhine, the graceful outlines of the Siebengbirge, the castled crag of Drachenfels, and the sheen, and near and distant flow of that abounding river.

The new chemical institution is provisionally intended for sixty students; the space, however, has been meted out so liberally, that accommodation can be supplied without inconvenience to a much greater number; besides this, the building has been so constructed as to allow of enlargement at any future time, by the addition of a second story, without detracting from the harmony of its structure, either as regards outward appearance or internal arrangement.

In addition to the various apartments required for educational purposes, for practical analysis, for scientific and technical investigations, for class exercises, and for the lectures, there are in the new building sets of rooms for the families and servants, apartments for three assistants, and also a magnificent residence for the director, consisting of a suite of rooms, which, as regards number and extent, would be very seldom met with in a private house. Lastly, there is a considerable number of well-lighted basement rooms, which have as yet no special use assigned to them, but the construction of which, on account of the greater depth of the foundations on the street side, could not be avoided. On any later enlargement of the institution, however, these rooms cannot fail to be adapted to some useful purpose.

The various departments of the building are spread over three floors, the basement, the ground floor, and the first floor. The first floor, however, extends over but a small portion of the structure, and is exclusively occupied by the private apartments of the director. But few of the rooms devoted to the purposes of the institution are found in the basement, as, for instance, the store-rooms, the rooms for metallurgical and other operations, requiring large quantities of fuel, those for medico-legal, and chemico-physiological research, &c. All the remaining space intended for educational purposes, viz: the laboratories, with their adjoining rooms for special operations, and side-rooms, balance-rooms, rooms for volumetric analysis, combustion-rooms, lecture-theatres, the halls for collections, the study and private laboratory of the director, the apartments of the assistants and other officers of the institution, are on the ground floor, an advantage which would not have been obtained had the site of the building been of more limited dimensions.

The *ground floor* contains no less than forty-four rooms, exclusive of vestibules,



corridors, and closets. After ascending the massive flight of stairs we enter the large vestibule, the rich architectural decoration of which at once bespeaks the dignity of a great public building dedicated to science. Before the spectator stretches a long corridor of considerable width, the main artery of the entire building. It is brilliantly lighted by a number of windows, (each nine feet high and four feet wide,) on the left side. The large folding doors at the further end of the corridor lead to the director's spacious study, which is provided with a large bow-window for microscopic observations. From this central situation the various parts of the great building are quickly and easily accessible.

There are three laboratories, each with permanent working-places for twenty students, with more than sufficient space, and every convenience for work.

The *first* of these laboratories is for *beginners*, that is to say, those who, having become acquainted with the rudiments of chemistry by attending lectures, enter the laboratory to become exercised in chemical manipulation, to make preparations, and to go through an elementary course of qualitative analysis.

The *second* laboratory is for *advanced students*, or those who, having acquired practice in qualitative experiments, are occupied with quantitative analysis, both ponderal and volumetric.

The *third* laboratory is for *young chemists* sufficiently conversant with the principal departments of chemistry to engage in original experimental investigations, either suggested by the director or chosen by themselves. In these laboratories the students have their permanent working-places. To each one is allotted for this purpose a table amply supplied with gas and water, as well as lock-up drawers and cupboards in which to keep apparatus, re-agents, &c.; in a word, his own chemical estate. At these working benches all ordinary chemical work, and all operations not requiring the special arrangements provided in other parts of the institution, are carried on.

In the side apartments attached to the three laboratories are three closets in direct communication with the main rooms. They are in charge of the respective assistants, and are intended for preserving delicate and costly apparatus, platinum and silver vessels, expensive re-agents, &c.

Besides the three laboratories in which the students, as already stated, have spacious and permanent benches, liberally provided with gas and water, and every facility for carrying off vapors and liquid products, there are a series of rooms for certain operations which cannot be well conducted in them, such as distillations, making of gases, heating of bodies in particular gas-atmospheres, and all experiments requiring large and complicated apparatus. This class of work is carried on in these special rooms or in the "evaporation-niches" let into their walls. Should, however, for any particular purpose, even more space or greater protection from noxious or offensive emanations be required, such as preparing sulphur compounds or similar substances, provision has likewise been made for such contingencies. Each working-room communicates with a covered colonnade, opening towards a back-court, and fitted up with gas and water and all the requisites for this special work. Flights of steps lead from the open sides of the colonnades down to the two back-courts lying between the three laboratories, and here the student finds an additional supply of water in the large central reservoirs, the tabular parapets of which serve as working-benches for a variety of operations.

Besides the chief apartments already mentioned, there are the following rooms: a laboratory for gas analysis, a volumetrical analysis room, two balance-rooms,



not only intended for the reception of chemical balances, but also of the more delicate physical instruments made use of in analysis, such as air-pumps, barometers, &c., two rooms for fusions and ignitions capable of being carried out by means of gas, a library, a large and excellently arranged lecture room capable of seating conveniently two hundred and fifty students, a chemical and mineralogical museum, store-rooms, &c.

The basement has nearly thirty rooms, which are at present mainly used for store-rooms, coal-cellars, lumber-rooms, &c., but capable of being utilized if necessary. Only the front block of the building has a second story; this contains a spacious and attractive suite of apartments, provided for the director of the institution, commanding the finest scenery in the world. There are abundance of rooms for servants, domestic offices, and storage.

The external aspect of the new laboratories is in perfect keeping with the scale of grandeur of the ground plan. The street front, 180 feet in length, consists of a long centre structure, two stories in height, with richly decorated windows and pillars, terminated by two end blocks of greater height, each containing a main entrance, with an ornamented balcony above. The side-front facing the city of Bonn, with the main entrance for students, has a depth of 250 feet, and consists of two parts, separated from each other by the carriage-way leading to the courts. One of these parts is the north-east corner of the front block; the other, perfectly symmetrical in itself, has for its centre the main vestibule, with its richly decorated entrance, and classically ornamented roof rising considerably above and projecting prominently from the remainder of this façade. On either side of this vestibule branch forth two long wings, which, though only of one story, are nevertheless of imposing attitude, being relieved, moreover, on the two corners by slightly projecting portions of somewhat greater height, and marked by the more elaborate architecture of the windows. The impression made on the spectator by the animated appearance of this front is exceedingly pleasing. The inner and outer façades and the principal architectural mouldings, are in stone. The architectural ornamentation of the interior is in keeping with that of the exterior. The principal vestibule, a hall of considerable dimensions, is lighted by a band of highly elevated windows running round the four sides of the building immediately under the roof. The ceiling is divided into ornamental squares, and the walls are enlivened by projecting pillars bearing caryatides, and a rich door architecture framing the entrance to the corridor.

The lecture-room is lighted from both sides through a range of windows, which are separated from one another by columnar pillars. Its walls and ceiling are correspondingly decorated in stucco and color.

The three laboratories, despite their necessary simple ornamentation, will not fail to make a favorable impression by their liberal proportions, by the enlivening effect of the wainscoting and the evaporating niches projecting from the walls above it, as well as by their elegant and in all respects suitable fittings. The rooms adjoining the laboratories, the small lecture-theatre and the museums, and the director's spacious residence, are all richly and tastefully ornamented, and are in all respects worthy of the institution to which it belongs.

The cost of the building, aside from the land, which belonged to the university, and of the equipment, was 183,000 thalers.



## II. BERLIN.

*Chemical Laboratory of the Frederick William University of Berlin.*

The University of Berlin, like that of Bonn, had its origin within the present century, having been founded in 1810, at a period when the pressure of foreign domination weighed almost insupportably on Prussia; and it will ever remain significant of the direction of the German mind, that the great men of that time should have expected to gather in the focus of science and letters the forces necessary for the political regeneration of their country.

To the present time, there have been three leaders of chemical science in this University since its foundation, Klaproth, Mitscherlich, and H. Rose, who have taught in succession, or at the same time. The existence of the Royal Academy of Sciences, instituted by Leibnitz in 1700, and reorganized by Frederick the Great in 1740, operated, among other causes, against the establishment of a great chemical institution at the university, as that academy was a scientific corporation, including chemistry within its scope. Ever since the foundation of the university the chemical chair has invariably been occupied by the chemist of the academy, and the university was thus exempt from the necessity of providing the chemical professor with working accommodations, which he already enjoyed in his capacity of academician. This double position, however, proved a disadvantage, when the demands for chemical instruction and investigation had increased in consequence of the rapid advance of science, and the industrial arts to which chemistry could minister.

In the autumn of 1863 the university and the academy suffered a heavy loss in the death of Mitscherlich; and not long after, by that of H. Rose. Professor A. W. Hoffman, F. R. S., then at Bonn, was selected to fill the chair thus vacated, principally on the grounds of the experience he had just acquired in organizing a chemical institution at Bonn, as it was universally conceded that the time had come when the building of a great chemical laboratory for the university of Berlin must be vigorously undertaken.

**SITE.** The site of the new Berlin laboratory is in the midst of the great representative institutions of the kingdom, and in close proximity to the university and the military medical school, at the east end of the beautiful street and promenade, "*Unter den Linden*," so called from its two parallel avenues of lime trees, which extend through the city from the monumental Brandenburg gate, in a direction from west to east. At the east end of this street, next to the splendid palace built by Frederick the Great for his brother, Prince Henry of Prussia, now devoted to the university, and the spacious edifice of the Academy of Sciences, near to other great public structures, the library, the academy of arts, the arsenal, and the royal residence, is the site of the new laboratory.

The relations of the university and academy with respect to their participation in the new institution, and the various preliminary conditions having been satisfactorily settled, the scientific details of the institution were arranged substantially after suggestions and plans of Prof. Hoffman at Bonn. The architectural details embodied by Mr. A. Creamer, an architect of great experience, were committed to two young architects, Messrs. Cornelius & Drawe.

The area occupied by the building is 21,680 square feet; and the building has two stories and a basement. The foundations rest principally upon arches thrown over concrete piles sunk through the yielding peat to the solid stratum below. The whole expense of the building and the additional grounds purchased (over 318,100 thalers), was borne by the Prussian government.



The broad frontage of the *Georgen-strass* was selected for the principal façade, with the main entrance for students. On the back of the large rectangle forming the site, parallel to the main edifice, runs a corresponding wing, and two structures, connected on either side by long galleries, and in the middle by a more massive block of buildings containing the great lecture-theatre of the institution. Thus two quadrangles were formed.

The principal front of the institution rises in two lofty stories over a massive basement, facing the *Georgen-strass*. The main entrance, consisting of three arched portals, is in the middle of the edifice. On the right hand corner there is a carriage-way leading to the quadrangles.

On entering by one of the middle portals and ascending three granite steps, the imposing vaulted *Vestibule* is reached, which is separated from the street by iron gates of ornamental trellis-work, closing the portals. Half-way across the vestibule a flight of nine steps, extending across the entire breadth of the hall, leads to the *Corridor* on the main floor. The construction of this splendid open vestibule was an architectural necessity, the Municipal Board of Works in Berlin not permitting the projection of steps into the street more than two feet.

The more important rooms of the institution are in the first or main story. The corridor above referred to extends through the entire length of the front building, being lighted in part from the staircase, and in part from three large windows appropriately situated.

**THE GROUND FLOOR.** The branch of the corridor on the right of the vestibule leads to a large glass door opening on a flight of steps which descends to the carriage-way, thus forming a communication between the ground floor and the quadrangles with the several wings that surround them. From this branch of the corridor, access is had to two rooms very near the carriage-way, viz: a small lecture-theatre for special lectures, and their recapitulations or reviews to be held by the assistants of the institution; and between this and the vestibule a special room for the lectures, as well as for the preparation of the experiments for the lectures. Being between the two entrances, these rooms are selected for these uses on account of their accessibility, being reached by students not working in the laboratory, without in any way interfering with the general business of the institution, while a great majority of the practical students are working in the first floor above, and have therefore only to descend the principal staircase.

The branch of the corridor extending from the left of the vestibule, leads to three important laboratories, opening into one another, which are fitted up for smelting operations on a large scale, involving the use of wood, coal, or coke. For this purpose the walls adjacent are traversed by a succession of flues for the several furnaces set up in the rooms. All these rise vertically to the height of about sixty feet, affording as great a draught as can be required. These rooms are so ample in their dimensions, however, as to be available for many other operations besides smelting; one of them, for instance, contains the large press of the laboratory, and another the steam-boiler, supplying the institution with distilled water, and heating, by means of pipes rising through the ceiling, the drying-ovens in the gallery on the first floor. In these rooms all the experiments made under great pressure are performed; for which special arches are let into the walls, provided with strong iron doors for the protection of the manipulator in case of explosion. The third room, in addition to the doors communicating with the corridor and the middle room, has a third door, leading into the *Collonnade* for open air work nearly one hundred feet in length.



This colonnade receives air and light through seven great arches, the middle one of which leads to a double flight of steps, descending to the quadrangle. This hall has all the requisites for chemical work, such as gas, water, etc., whilst three recesses in the partition wall serve to carry away such vapors as are to be avoided even in open air. The colonnade, in addition to the main staircase, has a spiral one uniting it with the first floor.

On the landing, directly opposite the main entrance, and visible from the street, is the entrance to the *Great Lecture Theatre*. This hall differs from that at Bonn by being much higher, rising through the two stories of the building, to an elevation of not less than 37 feet.

In direct communication with this theatre are the rooms for preparing the lectures and that containing the scientific collections of the institution. The *Preparation Laboratory* proper is accessible from the theatre by two doors, one on either side of a large niche behind the middle of the lecture table. This room is amply provided with all the requisites for chemical manipulation, and is well lighted, and has a flight of steps communicating with both the quadrangle and basement. It has also several other doors by means of which access is easy to the corridor, the waiting-room, the instrument-room, and the *Great Museum for the Scientific Collections of the Institution*, the latter being a magnificent hall 60 feet long and 25 broad, the arched roof of which is supported by iron columns.

The architecture of this museum suggests a division of the collections into three; minerals, rocks, and metallurgical products, occupying one section; the chemical collection proper, another; and models, drawings, diagrams, etc., the third. The specimens in the museum can be transmitted directly to the lecture theatre by means of a small truck, of the same height as the lecture table, running on wheels with India-rubber tires. There are several other rooms on this floor, which it is not necessary to enumerate and describe specifically, being applied to uses connected with the main object, and made convenient in their outfit, and accessible.

**THE FIRST FLOOR.** As has been stated, the first floor contains the most important rooms for manipulation, for only by this arrangement could the requisite amount of light be secured. The first room reached is the spacious *Operation Room*, lighted by the three middle windows of the front façade, and communicating on the right and left with two magnificent *Laboratories*, having a row of colossal windows on each side. The first of these laboratories is intended for beginners, the other for more advanced students. Each of them has ample space for 24 students, and is capable of accommodating a greater number if required. These rooms are most completely provided with all the requisites for work; in all the window pillars are evaporation niches, the flues of which communicate with the open air by chimney-pots, concealed behind the pillars of the attic running along the roof of the building. The walls of the laboratories are also traversed by flues, ventilating the large recesses here provided for fitting up lengthy pieces of apparatus.

From the great working laboratories for the beginners and advanced students branch out two *galleries*, nearly 100 feet long by 12 wide, one of which lies over the thoroughfare, and the other over the colonnade for open air work, each lighted by seven large windows. These galleries are not only useful as means of communication with the first floor and the apartments of the cross wing, but also for a variety of purposes requiring an amount of light which could not be otherwise secured.

Among the rooms which it is not easy to locate and specify, by a simple de-



scription, but connected with the operations prosecuted on this floor, are a *Library*, *Laboratories for Fusions and Ignitions*, a *Balance Room*, a *Laboratory for Scientific Research*, a *Gas Analysis Laboratory*, a *Photometric Room*, a *Private Laboratory*, *Combustion Room*, etc.

**THE BASEMENT.** The basement contains also a large number of rooms devoted to the objects of the institution; such as the laboratories for medico-legal investigations and physiological research, a room for the rougher operations for the lectures, a repository for chemicals, store rooms, coal cellars, wash-rooms, and household cellarage for the director's residence.

#### EXTERNAL ARCHITECTURE OF THE INSTITUTION.

The principal façade, in the Georgen-Strasse, is of brick; all the ornaments are terra-cotta from the celebrated works of March, of Charlottenburg. The ground floor is six feet above the level of the street and eighteen feet from floor to ceiling. The first or upper story has the same altitude; and the attic story, together with the ballustrade crowning the roof, is  $10\frac{1}{2}$  feet high. The whole building has, therefore, an elevation of  $52\frac{1}{2}$  feet above the level of the street; and the length upon this street is  $134\frac{1}{2}$  feet.

The angles between the arches of the windows furnish spaces for fourteen medallions of large size to exhibit in relief a number of portraits of celebrated chemists. As these are set at a height of eighteen feet from the street, it was necessary to make the likenesses over life size, the modeling of which was entrusted to the sculptor, Mr. W. Wolff, from whose models the medallions will be executed in terra-cotta by Messrs. March of Charlottenburg.

The selection of the persons thus to be distinguished, was entrusted by the architect to Prof. Hoffman; but as he desired the advice of others, Professors Dove, du Bois-Reymond, Gustav Magnus, Poggendorff, Rammelsberg, Riess, and Gustav Rose, all members of the physico-mathematical class of the Royal Academy of Sciences, gave this question their joint consideration. At a meeting, held March 1, 1866, it was, in the first place, decided that it would be best to honor the present leaders of chemical science by placing their busts in the entrance hall of the institution, and to dedicate the monumental medallions of the façade exclusively to the great teachers of the past. After considerable discussion, the following list was, with unanimity, ultimately adopted:

	BORN.	DIED.
Antoine Laurent Lavoisier, - - - - -	1743	1794
Karl Wilhelm Scheele, - - - - -	1742	1786
Henry Cavendish, - - - - -	1731	1810
Joseph Priestly, - - - - -	1733	1804
John Dalton, - - - - -	1766	1844
Claude Louis Berthollet, - - - - -	1748	1822
Louis Joseph Gay-Lussac, - - - - -	1778	1850
Humphrey Davy, - - - - -	1778	1829
Jacob Berzelius, - - - - -	1779	1848
Eilhard Mitscherlich, - - - - -	1794	1863
Martin Heinrich Klaproth, - - - - -	1743	1817
Heinrich Rose, - - - - -	1795	1864
Leopold Gmelin, - - - - -	1788	1853
Charles Gerhardt, - - - - -	1816	1856
Auguste Laurent, - - - - -	1807	1853

The two last named chemists, united during their life time by ties of friendship, and having laid the foundation of the chemical views of the present day by their joint labors, are framed in the same medallion.



## THE AQUARIUM AT BERLIN.

The first step towards realizing the long-cherished idea of founding an Aquarium on an extensive scale in Berlin, was taken July 8, 1867, when a joint-stock company, formed for this purpose, held its first meeting, when, chiefly through the exertions of a wealthy merchant of Berlin, F. Stehlschmidt, the sum of 200,000 Prussian dollars was raised. Of the many plans submitted, the one by the architect, Wilhelm Luer, was accepted. The eminent zoologist, Dr. Alfred Brehm, was entrusted with the technical and scientific superintendence of the building, and the work was commenced at once. Great and manifold were the difficulties encountered in this undertaking. From the Harz and the Thuringien mountains, from the banks of the Rhine and the valley of the Aar, from the mines of Silesia and Saxony the materials had to be brought, for all the pillars, vaults and walls of the building were to be of genuine specimens of various rocks and minerals to the exclusion of all artificial imitations. Great technical difficulties also presented themselves in ventilating, heating and lighting the edifice; but by the indefatigable efforts of the men superintending the building, and by the thoroughness and eminent skill of the best technicians of Berlin employed in the work, all these difficulties were successfully overcome, and in the month of May, 1869, the establishment was opened to the public.

The aquarium proper occupies only a portion of the building, which covers an area of 13,550 square feet. It contains no less than 118 cages, reservoirs, and ponds, for the reception of the different animals; the length of the galleries is 780 feet, and their height varies from 15 to 17 feet, the open aquaria holds 6,000 cubic feet of water, and the reservoirs 13,220; 2,000 persons can, at one time, without being inconveniently crowded, visit the institution. The number of specimens of living animals already now very large, is constantly being increased, and will soon reach 40,000, the highest number contemplated.

The building is located on the corner of *Schadow* street, and that magnificent thoroughfare, "*Unter den Linden*." After having mounted a massive staircase the visitor enters through a glass-door, the *desert* or *serpent's gallery*, a broad and lofty hall, the walls of which are occupied by the cages with serpents and other amphibious animals. These cages are all very large, and convey as far as possible a faithful idea of the localities in which the various animals are found. Here are to be seen harmless European snakes as well as the rattle-snake, the moccasin-snake, the boa-constrictor, and many other varieties. This gallery opens into a ravine 31 feet broad and 55 feet high, called the *geological grotto*, whose walls, in a hitherto unsurpassed manner, form an exact representation of the different geological layers of the earth's surface, all composed of genuine specimens; a cascade, whose foaming waters tumble over the moss and fern-grown rocks forms the back ground of this fairy-grotto; the visitor mounts a balcony, from which an excellent view of the romantic scene below may be obtained; parrots and other birds of brilliant plumage are resting on the projecting rocks, or on the branches of the many tropical trees, and down among the rocks at the bottom of the cliff turtles have their home. A broad stone-staircase of ten steps leads from the geological grotto to the primeval forest of the tropics; in the centre of this hall is a magnificent cage of airy wire-work 28 feet high and 44 feet in diameter; more than 1,200 birds; amongst the rest 25 varieties of parrots inhabit this cage; round about there is a broad and high walk of natural rock in the clefts of which there are cages, reservoirs, and small ponds. There is an alligator-pond with ten alligators, a turtle-pond, a reservoir for nest-building, fishes and cages with



sweet-singing birds, cages with flying squirrels, desert-mice, eagles, and monkeys. On leaving this hall a wide perspective opens, and we enter the *polar or arctic grotto*, after having passed through the *fresh-water grotto*, inhabited by fresh-water fish and singing birds. There murmuring streams of water are flowing between the rocks. From this grotto we descend a spiral staircase to the bottom of the great ocean. On our way thither we pass reservoirs in the rocky walls, representing the different kinds of pisciculture, with illustrations of the French system, Kuff's system, and Brehm's system. Before entering the large ocean aquarium we pass the beaver-pond, where some beavers are building their artificial structures. In the basins of a long gallery of natural rock we see all those fishes which belong to fresh-water, but which, at certain times of the year, go out into the ocean; then follows a large number of reservoirs illustrating the plants and animals of the different seas, first the North sea, then the Baltic-reservoir, and in the centre an immense aquarium representing the Atlantic ocean with its bays and gulfs; through a narrow entrance called the Strait of Gibraltar, we reach the last of the series, the Mediterranean reservoir.—*Über Land und Meer.*

*Elementary and Technical Education for England.*

The result of an examination of the great industrial districts of France, Switzerland, and Germany, and of the technical institutions which supply them with engineers and foremen, and of the public schools which give to all the workmen, in most prosperous sections, a good elementary education, Mr. Samuelson, in his Letter on Technical Education, embodies as follows:

*First, as to Elementary Education.* Let no child under 12 be allowed to work until it can read and write. Make it the duty of every parent to see that its children have the means of elementary instruction.

Encourage elementary schools by special grants to establish advanced classes.

Assist the pupils of elementary schools who have shown remarkable ability to continue their education in a superior school.

*Secondly, as to Technical Education.* Give a thoroughly scientific training to a small number of young men to qualify them as professors of science. Supplement local efforts to establish or to extend secondary or superior scientific schools, by building grants, and by the endowment or partial endowment of professorships. Let one condition of assistance to a scientific school be, that a perfecting school (*fortbildungsschule*) shall be affiliated to it; and of the endowment of a professorship, that the professor shall teach in the perfecting school.

Mr. Samuelson evidently favors the introduction of the superior mental training of the gymnasium into the preparation of pupils for the polytechnic schools, as well as a larger infusion of literature into the Gewerbe Schulen. In speaking of the Gewerbe Schule of Barmen, in Westphalia:

It has about 200 pupils, five-sixths of whom leave the school at the end of three years (in the second class), to enter into some industrial or mercantile occupation, the other sixth remain and generally go from the school to a Polytechnic institution, not unfrequently serving a short apprenticeship of one or two years, in a workshop, between the termination of their school career, and their entrance upon the course of higher instruction. The third and fourth classes, forming the lower school at Barmen, include French, history, and geography, arithmetic, algebra, natural philosophy, geometry, and drawing. These studies are continued in the second class, with the addition of chemistry, and the extension of drawing to machine details. In the first class, mineralogy, building, construction, and mechanics, theoretical and applied, and practical work in the shop, are added.

Mr. Samuelson does not favor the system of apprenticeship schools on the part of the government. "They fall properly within the province of benevolent individuals and societies, and their success will depend on the judgment with which they are organized and superintended."



## SPECIAL INSTRUCTION IN SAXONY.

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### INTRODUCTION.

THE Kingdom of Saxony, on an area of 6,777 English square miles, in 1864 had a population of 2,343,994, of which number 1,248,677 were engaged in mechanical and manufacturing industries, 559,013 in agriculture, and 172,946 in commerce.

The total annual expenditure of the government of the Kingdom of Saxony during the financial period 1863-66, amounted to 12,356,352 thalers, of which sum about 300,000 thalers were expended in public instruction, independent of all local expenditure, which amounted to about 1,000,000 thalers. A system of public instruction in Saxony has been in operation since 1580, and under its beneficent influence there has grown up a precious national inheritance of school habits, which now secures the regular attendance of all children of the legal school age, at some school, public or private, and furnishes the higher institutions of learning, and the numerous special schools of agriculture, architecture, commerce, mining, and other industries, with well-prepared quota of students. Mr. Mundella, member of parliament, and large employer of laborers in England and Saxony, in a recent speech in Nottingham (his place of residence), said that he had never found a native born Saxon who could not read and write.

The institutions of public instruction, administered by the minister of education and ecclesiastical affairs, are as follows :

1. *Primary Schools.* Of these there were in 1867, 1,976 schools, with 3,996 teachers, and 400,229 scholars (199,446 boys, and 2,783 girls); 93 Sunday schools, designed to complete the elementary education, with 7,024 scholars; and 80 schools for poor children in cities.

2. *Secondary Schools.* There were in 1868, 9 gymnasia, with 2,066 scholars, and 159 teachers; 7 gymnasia with real-classes, with 1,440 scholars, and 166 teachers; 3 real-schools and progymnasia combined, with 874 scholars, and 54 teachers; 3 real-schools, with 1,183 scholars, and 55 teachers; making a total of 22 secondary schools, with 5,563 scholars, and 434 teachers.

3. *Superior Schools.* The University at Leipsic, in 1867-68 had 111 professors, and 1,190 students (297 theology, 362 law, 181 medicine, 350 philosophy and philology).

4. *Special and Professional Schools.*

- 3 Public commercial schools, with 177 scholars.
- 15 Commercial schools for apprentices.
  - 1 Commercial school for young ladies, with 112 pupils, and 9 teachers.
  - 1 Polytechnic school, at Dresden, with 360 students, and 28 teachers; and connected with this school there is a modeling and ornamental drawing school, with 16 scholars.
  - 1 Higher industrial school, at Chemnitz, with 225 pupils, and 19 teachers. Connected with this school there is 1 royal work-masters' school, with 82 scholars, and 10 teachers.
- 5 Baugewerkschulen (architectural schools for masons and carpenters), with 548 pupils, and about 20 teachers.
  - 1 Higher weaving school, at Chemnitz, with 33 pupils, and 4 teachers.
  - 1 Academy of forestry and agriculture, with 13 teachers, and 91 students.
  - 1 Agricultural academy, with 38 students.
  - 1 Mining academy, with 13 professors, and 51 students.
  - 1 School for practical miners, with about 60 pupils.
  - 2 Mining schools, with 64 pupils.
  - 2 Stenographic institution, with 130 pupils.
  - 1 Normal school for training teachers in gymnastics, with 10 teachers, and a varying number of pupils.
  - 1 Royal military school, with 124 scholars.
  - 1 Royal veterinary school, with 39 students, and 9 teachers.
  - 4 Nautical schools (for pilots on the Elbe), with 60 to 70 pupils.
  - 2 Music schools, with about 80 pupils.
  - 7 Weaving schools, with about 550 pupils.
  - 2 Fringe-making schools, with about 300 pupils.
  - 1 Tailors', or *Mode* academy, with 38 pupils, and 5 teachers.
  - 3 Straw-working schools.
- 30 Lace-making and embroidering schools.
  - 2 Schools for deaf mutes, with 208 pupils, and 28 teachers.
  - 2 Schools for the blind, one with 128 pupils, at Dresden, and a preparatory school, at Hubertsburg, with 17 pupils.
  - 2 Academies of fine arts, one at Dresden, founded in 1705, with 136 students, and a second, at Leipsic, founded in 1764, with 100 pupils.
  - 2 Academies of arts.
    - 1 Conservatorio of music, with 146 students, and 14 teachers.
- 12 Teachers' seminaries, with 1,177 students, and 164 teachers.



## SYSTEM OF SPECIAL SCHOOLS IN SAXONY.

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As preparing for a higher technical career, we will notice, first, a class of schools which belong also to the general system of public instruction.

### I.—THE REAL SCHOOLS.

#### 1.—*Object.*

These schools may be said to correspond to the American or English High Schools, so far as the latter are designed for a good general education, with the exception of the classical department. Here flock together all those who want an education superior to that which is acquired in the elementary schools and are not destined for the university; *e. g.*, such as wish to be officers in the postal or custom service, or architects, farmers, engineers, or artists, in order to pursue a higher course in one of the professional academies, and all such as desire to enter business life with a cultivated mind. It should be understood that the graduate of a gymnasium (college) is by no means prevented from entering the polytechnic school, the academy for miners, the academy for foresters and farmers, and the academy of arts; but, for this purpose, the Real School is to be preferred, because mathematics and modern languages are more particularly attended to, whilst in the gymnasium the English is not obligatory, and in some colleges mathematics and French are considered of less importance, and treated accordingly. In Freiberg and Tharand the graduate of a gymnasium is at once admitted; the graduate of a Real School conditionally, if he has a good record in mathematics.

#### 2.—*Number and Location.*

There are *seven* Real Schools in Saxony, each with a large number of pupils; in all, 1,892 pupils, and 105 teachers in the last year. The schools in Dresden, (2,) in Leipsic, and Chemnitz are city schools, and supported by the municipalities; the last mentioned with a state grant. In Annaberg, Plauen, and Zittau are royal schools; the two latter joined to the gymnasium; the first mentioned, as well as that in Chemnitz, combined with a pro-gymnasium of three classes. The Royal School in Annaberg, with 13 teachers, (salaries: 1,200, 800, 900, 800, 700 thalers, etc.,) and 220 pupils, expended, in 1866, 8,482 thalers, and re-

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\* Prepared for the Commissioner of Education by Dr. Hermann Wimmer, Dresden.

ceived from the state 5,200 thalers. The Real School in Neustadt, Dresden, with 16 teachers, expends yearly 12,500; the other in Dresden, 10,000; that in Leipsic, (the first in Saxony, founded 1834,) with 20 teachers, 16,600 thalers. The tuition fee in Leipsic and Chemnitz is 20-30, in Dresden 30-36 thalers.

The regulation of 1860, which caused a greater uniformity in those schools of a comparatively new date, and formerly of a different character, requires six classes, (the pupil to have completed his 10th year,) establishes a *maturitäts* examination prescribing the needed requirements, and gives the approved graduates the right to enter without further examination the above-named academies, or to enter the post office, custom house or telegraph office. At this examination the principal of the polytechnic school presides.

### 3.—*Classes and Plan of Instruction.*

Of the six classes the lower are generally crowded, and therefore divided into parallel classes, since the regulation does not allow more than 40 pupils in one class. Thus, the 5th class in Chemnitz has four parallel classes with about 30 pupils in each, the 4th of three, the 6th and 3d of two parallel classes, whilst the first class has 13 and the second 15 pupils in all. This fact is explained by the circumstance that for most pupils the Real School is the highest school they attend before entering, at their fourteenth year of age, on their commercial or technical apprenticeship, whilst the small number of pupils in the highest classes consists only of such as wish to enjoy the benefits of the examination as graduates, most of them with the intention of continuing their education in the professional academies, except the university. For our purpose, therefore, it will be sufficient to point out the studies of the highest class, which may best show the attainments of a graduate of these schools.

First or *highest* class, (in Chemnitz :)

*Religion*, 2 hours a week.

*German*, 5 hours.—*a.* History of literature; read two dramatic pieces of Schiller and Lessing. *b.* Rhythm and the various kinds of poetry; practical exercises. *c.* Review of the compositions written by the pupils once a month. *d.* Exercises in free elocution and in declamation, with a verbal criticism made by the pupils.

*French*, 4 hours.—Grammar finished; read the *Avare* of Moliere; free compositions; extemporalia; exercises in speaking.

*English*, 3 hours.—*a.* Read Shakspeare's *Julius Cæsar*, Dickens' *Christmas Carol*. *b.* Grammar. *c.* Exercises in writing; a composition every third week, and an extemporale weekly; exercises in speaking.

*History*, 2 hours.—Modern history; review of the history of ancient times and middle ages.

*Geography*, 3 hours.—*a.* political; Western Asia, Africa and Germany, (politically and physically.) *b.* Mathematical; the apparent and real movements of the celestial bodies; the solar system and the fixed stars.



*Natural History*, 1 hour.—Mineralogy.

*Chemistry*, 3 hours.—Review and further study of inorganic chemistry, with particular reference to metals and their associations.

*Natural Philosophy*, 2 hours.—Mechanics; some parts of the theory of light.

*Arithmetic*, 4 hours.—Logarithms reviewed and continued; application of the same to numerical accounts; use of *hülfswinkel and Gauss' Table*; equations of the 2d and 3d degree; algebraic functions; general qualities and approximate solution of higher equations; the arithmetical and geometrical progressions, (*reihen*;) interest, rents, sinking funds, and insurance.

*Geometry*, 3 hours.—Trigonometry concluded; stereometry; review of planimetry and trigonometry.

*Surveying*, 1 afternoon in summer.—Description and use of the single surveying implements; measuring of straight and curved lines; surveying of single and continuous grounds; profiles; drawing of plans.

About *Latin*, the Regulative says that though very desirable for all pupils, it is obligatory only on such as will pass the *maturitäts* examination; for all others *facultative, i. e.*, left to choice.

The general plan of instruction, as given in the Regulative, is as follows:

	VI.	V.	IV.	III.	II.	I.
	Hours per Week to Each Study					
Religion.....	4	4	3	3	2	2
German.....	4	4	4	3	3-4	3-4
Latin.....	6	4	3	3	3	3
French.....	-	6	7	4	4	4
English.....	-	-	-	4	3	3
Geography.....	2	2	2	2	2	2
History.....	2	2	2	2	2	2
Natural History.....	2	2	2	2	1	1
Natural Philosophy.....	-	-	-	2	3	2
Chemistry.....	-	-	-	-	2	3
Arithmetic.....	4	4	4	2	2	1
Algebra.....	-	-	-	3	3	3
Mathematics.....	-	-	2	3	3	3
Drawing.....	2	2	2	2	2	2
Calligraphy.....	2	2	1	-	-	-
Singing.....	1	1	1	1	1	1
	35-36	36-37	36	33	33	29
Gymnastics.....	2	2	2	2	2	2

Gymnastics are considered as recreation.

II.—COMMERCIAL SCHOOLS.

I.—PUBLIC COMMERCIAL SCHOOL.

1.—Number and Location.

There are three public commercial schools in Saxony—in Leipsic since 1831, in Chemnitz since 1848, and in Dresden since 1854—all founded by the Merchants' Associations of the respective towns. They belong, like all the following technical schools, except the two academies in Frieberg and Tharand, to the Home Department, and the two former receive an annual supply to their expenses (a) of 1,560 thalers, (b) of 800 thalers, with an additional supply of 200 thalers from the city funds. The annual expenditure was, in 1862, Leipsic, 12,000; Chemnitz, 56,000; Dresden, 12,000 th.; in Dresden, entirely

Documents.

1. *Regulatio für die Realschulen im K. Sachsen*, Dresden, 1860; 2. *Programme von Neustadt*, Dresden, of 1867; 3. *Programme von Chemnitz*, 1867, 1866, and of 1864; 4. Plan of Lessons in the Real School at Neustadt, Dresden.

covered by the income of school-money, which amounted in 1866 to 17,617 th., with a surplus of 1,075 th. over the expenses.

The terms in Dresden are 120 th., or £18, for the first year; 100 th., or £15, for each of the succeeding years; in Leipsic, 150, 120, 100 th., and in Chemnitz 80 thalers. Each pupil must remain at least one year.

### 2.—*Plan of Instruction.*

The commercial schools prepare their pupils for entrance into practical business life, and have in view their complete preparatory training for mercantile pursuits in a course of three years.

The plan of instruction is as follows:

	III. <i>First Year.</i>	II. <i>Second Year.</i>	I. <i>Third Year.</i>
Commercial science and law.....	1	2	3
Political economy.....	—	—	2
Book-keeping—merchants' accounts.....	1	2	2
Correspondence.....	—	2	2
Commercial arithmetic.....	5	3	2
Mathematics.....	3	3	2
Natural history.....	3	—	—
Natural philosophy.....	—	3	—
Mechanical technics.....	—	—	2
Chemistry.....	—	—	2
Raw material of trade.....	—	—	1
Geography and statistics.....	2	2	2
History.....	2	2	2
German language and literature.....	4	3	3
English language and correspondence.....	4	4	4
French " " ".....	4	4	4
Italian, (not obligatory).....	—	2	2
Calligraphy.....	2	1	—
Drawing.....	2	2	2

In the upper classes English and French are taught by natives. The collections of the school consist of a library, maps, apparatus, and samples of goods.

### 3.—*Pupils.*

The number of pupils in Dresden was, at Easter, 1867, 68, of which there were 25 foreigners, (6 from Norway, 1 Sweden, 6 Russia, 2 France, 2 England, 4 Holland, 2 Italy, etc. ;) in Leipsic 56, at Easter, 1865, (16 foreigners ;) in Chemnitz, 1867, 53.

The pupils visited in the course of the year many different factories in the neighborhood.

In connection with these three higher commercial schools there are

## II.—COMMERCIAL SCHOOLS FOR APPRENTICES.

Besides the three schools, there are twelve more in other towns of Saxony. Though belonging to a lower class of schools, to be mentioned below, they cannot well be separated from the higher commer-



cial schools, because they have the same board of trustees, members of the Merchants' Association, the same teachers, and the same objects in view, though differing in degree and the time given to the several studies.

The pupils have to pay in Leipsic 18, in Chemnitz 24, in Dresden 36 thalers, if they are sons of members of the corporation; if not, in Leipsic 24, in Dresden 36 thalers. The number of pupils in all three schools was 349, who are taught in 10-14 hours a week, (in Leipsic, 7-8, or 8-9, and 2-3,) in three classes of as many years.

The plan of studies in Leipsic is as follows :

	III. First Year.	II. Second Year.	I. Third Year.
German language.....	2	1	1
English language.....	—	2	2
French language.....	2	2	2
Merchants' accounts.....	3	2	2
Commercial science.....	—	1	1
Book-keeping, &c.....	—	1	1
Correspondence.....	—	—	1
Geography.....	1	1	—
Calligraphy.....	2	—	—
	10	10	10

The character of these schools is everywhere the same, though, of course, the three which are joined to the higher commercial schools enjoy greater advantages. I may mention that in Freiberg, where there is a separate school for apprentices in mercantile business, the expenditure of the last year was 1,921 thalers, except the expenses for the library and premium funds.

### III.—THE COMMERCIAL SCHOOL FOR YOUNG LADIES IN LEIPSIK.

A commercial school was established in 1863 for young ladies who are more than 14 years old, and wish to acquire the knowledge needed for business life, (commerce, post office, telegraphing, etc.) It received from its beginning aid from the state of several hundred thalers a year, and a like sum from the town of Leipsic, so that 24 free and half-free scholarships could be established. Until Easter, 1867, it had in all 242 female pupils; at present, 112 in *five* classes, with nine teachers. The tuition fee is 36-48 thalers annually, and is now double what it was

#### Documents.

- a. Public Commercial School, &c., in Leipsic : 1. Statuten von 1830, p. 12; 2. Prospectus, 1866; 3. Mittheilungen, (communications,) von Dr. Odermann, p. 23, 1865; 4. Haussregulatio for I, (higher,) *abtheilung*, 1867; 5. Sections plan for I, (higher,) *abtheilung*, 1866; 6. Sections plan für die II, *abtheilung*, 1866.
- b. Public Commercial School in Dresden : 7. Programme, p. 55, 1867; 8. Dresden Commercial School, English and Dutch, 1867; 9. 2 Sections plan für I and II, 1867.
- c. Public Commercial School in Chemnitz : 10. Programme, p. 28, 1867; 11. 2 Prospective von I and II, 1867; 12. 2 Disciplinary (rules of discipline) *vorschriften für* I and II, 1867.

in 1864. The course embraces *two years*, with 18–24 *lessons* a week, given from nine to twelve and three to six daily, and comprises all the branches taught in a commercial school, (German, French, English, commercial arithmetic, book-keeping, correspondence, commercial science, political economy, commerce, history and geography, ornamental drawing, etc.) Besides, there is a course in *stenography*, and a *French club* from 6 to 8 on two evenings for practice in French conversation. It is not obligatory to join these two courses, and an extra charge is made. The French conversation in the club is conducted by a lady. Of the 242 ladies who passed through the course in the school during the first four years, 47 were 20–33 years old; the rest, 14–19. Many of them found employment when leaving the school.

Since the establishment of that school two more have sprung up, in Dresden, formed by a teacher of the Commercial School, and in Chemnitz founded by the Trades' Union; but they rank more with the evening schools, (for continuing education,) to be mentioned hereafter. The school in Dresden has 10–12 pupils, who have to pay 24 thalers a year, and are instructed seven hours a week: in arithmetic, two; German, two; calligraphy, one; book-keeping, two; and commercial science, one.

### III.—THE POLYTECHNIC SCHOOL AT DRESDEN.

#### 1.—*Origin—Receipts—Stipends.*

The Royal Polytechnic School was established in 1828\*, called then the Technical Institution, with 11 teachers, all of whom were also employed in other institutions of Dresden. But its growth was so rapid, especially after its present building had been erected (see annual report of 1864-65) in 1846—for which the legislature had granted 70,000 thalers—that, in 1851, under the present excellent principal, Professor Hülse, it received its present name, and in 1853 had twenty-one teachers, most of whom belonged exclusively to the school.

Now it has 28 teachers, 17 of them bearing the title professor, (Schubert, Geinity, Schneider, etc.,) beside nine subalterns, with 376 students.

The Polytechnic School is under the immediate control of the Home

#### Documents.

1. Prospectus of the Commercial School for young ladies in Leipsic; 2. Report of the school; Easter, 1867; pp. 14–23.

\* There existed before that time in Saxony the Academy of Arts since 1764, (its "Industrial School" was separated in 1828, and established as the Technical School;) the Mining Academy, in Freiberg, since 1766, and the Forest Academy in Tharand, 1816. Before that time Polytechnic Schools existed in Germany: in Prague, 1806; in Vienna, 1815; in Berlin, 1825; in Carlsruhe, (Baden,) 1825; in Nuremberg and Munich, 1825.



Department, and has a yearly income of 30,200 thalers, of which 23,000 are received from the State, and the rest paid by the students in tuition fees. The latter sum would amount to 2,068 thalers more, if it was not released to the poorer students. The expenses for teachers amount to 20,054 thalers; for the library, etc., 5,952 thalers, and other expenses, 4,552 thalers.

The value of the library, of more than 10,000 volumes, and of the fifteen collections, is estimated at 65,000 thalers, and these are continually growing, since the state pays annually for the library 1,350 thalers, and for the increase of the collections 3,000 thalers and more. For obtaining a correct estimate of the library, there is made, at the end of each year, a deduction of 5 per cent.

The students have to pay 40 thalers a year, or 20 for each course of six months. Those who wish to attend the lessons only in one or several branches of instruction may be admitted and pay accordingly, viz: 2 thalers annually for any one lesson a week; 10 thalers for constructing machines; 20 thalers for the practical exercises in surveying; 8 thalers for one, 32 thalers for four or more, in exercises in the laboratory. All that are not Saxons have to pay one-half more, *i. e.*, 60 thalers annually for the full course.

This pay was released in the last year to 73 students, amounting to 2,068 thalers. Nine students received out of state funds 342 thalers. From the various funds established in recent times by benefactors, 36 students received together 1,610 thalers in the last year. Besides, one student, who had completed his studies, received 200 thalers for further improvement, either by travelling or studying in any university. The same person may have this grant for several years of not less than 100 nor more than 300 thalers. This fund for "travel stipends" was founded 1853 by the professors of the school, and is growing fast by public lectures given by them for this purpose, and by private gifts.

## 2.—*Organization of Studies.*

The Polytechnic School is divided into two departments, the lower of which, called the general course, prepares for the professional departments, and extends over three terms, each of six months. To enter the lowest class the aspirant must be at least sixteen years old, and must have either completed the full course in a real school or gymnasium, or of the third class in the Industrial School in Chemnitz, or show in an examination the same acquirements. This examination embraces, in mathematics, planimetry, stereometry, trigonometry, and equations of the third degree; experimental philosophy; geometrical drawing, and

the elements of projection. The candidate may enter a higher class if showing the needed attainments.

This general course has two classes, the lower of one "semester," the upper of two, five or one year, in all eighteen months. The plan of studies here will be easily understood from the studies in the following classes, and from the required attainments on admission.

The professional course is divided into *four* sections :

- A. The Mechanic-Technical School, for constructing machines, etc.
- B. The Engineer School, for surveying, and for building railroads, bridges, etc.
- C. The Chemical School.
- D. The school for training teachers of mathematics, natural philosophy and technical branches.

According to the plan of organization, the course of studies, and the hours for work to each study in each class, are as follows :

SECTION A.—*Mechanical Engineering.*

	III. <i>First Year.</i>	II. <i>Second Year.</i>	I. <i>Third Year.</i>
Higher mathematics.....	4	—	2
“ mechanics.....	—	4	—
Doctrine of "solidity" ( <i>festigkeit</i> ).....	—	4 wi.	—
Doctrine of machines.....	6	4	2
Drawing and designing of machines.....	6-8	16	20
Mechanical technology.....	4	3-4	3-4
Hydraulics.....	—	4 su.	—
Exercises in sketching.....	2-4	—	—
Higher physics.....	—	—	2
Mineralogy and petrography.....	4	—	—
Architecture (B).....	2	—	—
Architectural drawing (B).....	4	—	—
Political economy.....	—	—	4
Elements of philosophy, short history of ph., logic, æsthetics, psychology.....	—	—	2
History of literature.....	2	2	—

SECTION B.—*Civil Engineering.*

Besides higher mathematics, higher mechanics, doctrine of "solidity," hydraulics, mechanical technology, mineralogy and petrography, political economy, mental philosophy, history of literature, in which the classes of the respective years' course are combined with A, the following subjects are taught particularly in this section :

	III. <i>First Year.</i>	II. <i>Second Year.</i>	I. <i>Third Year.</i>
Geodesy.....	5 wi.	4 wi.	—
Geodesy and astronomy.....	—	—	2 wi.
Exercises in surveying.....	1 day.	The whole September.	—
Drawing of plans.....	2-4 wi.	4	—
Architecture, (A with B).....	2-4	1-2	—
Architectural drawing, (A with B).....	4-8	—	—
Construction of roads, hydraulic architecture.....	—	4	—
Construction of bridges.....	—	—	4
Designing plans.....	—	12	16
Geognosy.....	—	3	—
Geognostical excursions.....	—	1 aftern'n su.	—
Measuring exercises, (in the room).....	—	—	4
Higher physics.....	—	—	2



SECTION C.—*Chemistry.*

Mineralogy, general doctrine of machines, mechanical technology, political economy, history of literature—A.

Geognosy, with excursions; architecture, with drawing—B.

	III. <i>First Year.</i>	II. <i>Second Year.</i>	I. <i>Third Year.</i>
Theoretical chemistry.....	2	2	2
Chemical technology... ..	2	2	2
Chemical exercises.....	3	20	20

SECTION D.—*For Training Teachers.*

Higher mathematics and mechanics, hydraulics, doctrine of machines, mechanical technology, mineralogy, political economy, mental philosophy—A.

Surveying, 5 hours; geognosy, with excursions; higher physics—A and B.

Chemistry, 2 hours, less exercises, with C.

	III. <i>First Year.</i>	II. <i>Second Year.</i>	I. <i>Third Year.</i>
Higher physics.....	-	2	2 besides 4 with A & B.
Physical exercises.....	-	4	4

Besides, there are lessons for all, *who choose*, in stenography, 3 hours in winter; French, 2-3 hours in several classes; English, 2-3 hours in do.; gymnastics, 2-3 hours in do.

For the students of the upper classes: Stone-cutting, 2 hours, (for B;) book-keeping, 2 hours in winter; banking, (bills of exchange,) 1 hour in winter; theory of fire-establishments, 3-4, (for A,) (*feuerungs-anlagen*;) Saxon law, 2 hours for I in all sections; excursions to important manufactories in the neighborhood.

The students are required in the last year to make the sketch of a factory establishment; they are, therefore, for the vacations, recommended to a manufactory, in order to study it and prepare for their task.

At the end of the last course, all sections pass a "closing examination," as it is called, to which all who apply for it, and want a testimonial as graduates of the Polytechnic School, are admitted. The students have to solve the problems given in their respective branches,\* from 4 to 6 hours being given to each composition. Besides, they have to show their practical skill, by laying before the examining committee designs and sketches, a chemical analysis, and a physical investigation. Of 246 applicants from 1852 to 1867, 234 received the desired testimonial. After this examination, if passed, the graduate has to work practically with an engineer, &c., and then, with satisfactory testimonials, both of the Polytechnic School and its master, with whom he must have worked at least three years, be it continually or by intervals, he is admitted to the state examination for engineers. Until 1867, 141 per-

\* A.—Doctrine of mechanics, mechanical technology, higher mathematics and mechanics, higher physics.

B.—Civil engineering, (roads, hydraulics, bridges, architecture in general, measuring and astronomy, higher mathematics and mechanics, higher physics, mineralogy and geognosy.)

C.—Theoretical chemistry, chemical technology, mineralogy and geognosy.

D.—Higher mathematics and mechanics, higher physics, measuring and astronomy, theoretical chemistry, mineralogy and geognosy.

sons applied for examination, and 38 were not admitted or did not succeed. Of the 93 who succeeded, 56 became civil engineers, 6 mechanical engineers, 12 architects, (*baumeister*,) and 19 inspectors of the fire insurance, as yet chiefly a matter of government in Saxony, and so far obligatory on all proprietors in the kingdom, besides the many private fire-insurance companies here.

The committee of the state examination consists partly of professors of the Polytechnic School, to whom is added the professor of architecture from the Academy of Arts, partly of practical engineers and architects in the highest positions in their respective professions.

The higher architectural school (*bauschule*) is not joined here, as elsewhere, to the Polytechnic Institution, but to the Academy of Fine Arts, which is described hereafter. But the students of architecture in the academy have to attend the mathematical lessons in the Polytechnic School, if they wish to pass the said state examination for engineers and architects. Hence the professor of architecture in the academy is a member of the examining committee.

Joined to the Polytechnic School is a—

### 3.—*Modelling and Ornamental Drawing School.*

It is intended to train (*a*) good modellers for the industrial branches, viz, for decorative forming in wood and stone; for iron foundries, &c.; (*b*,) ornamental drawers for weaving and printing, and to give opportunity to get a general instruction in decorative, porcelain and plate painting, lithography, engraving, &c. The time of the whole course is generally five years, but may be shorter, if the pupil enters well prepared. For admission the pupil must be at least fifteen years old; nothing but a good elementary education is required, though the knowledge of the respective trade is desired. Generally they are admitted by way of trial in the first course of six months. The pay is six thalers annually for a Saxon, and nine thalers for a foreigner. The pupils may attend the lessons of the Polytechnic School, and if satisfactorily prepared, have to attend the teachers on anatomy in the Academy of Arts, and in the Veterinary school.

Of the above-mentioned 376 students, there were in the professional schools 134; in A, 43; B, 69; C, 18; D, 4; in the general course, 141; for single branches, 85, and 16 in the Ornamental Drawing School.

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#### Documents.

1. Plan of organization of the Polytechnic School, 1865, p. 67; 2. Prospect of 1867; 3. *Die Polytechnische Schule während der ersten 25 Jahre, von Prof. Hülsse*, 1853, p. 54; 4. Programmes and Reports until 1867, [thirteen;] 5. *Die Baugewerkschule in Dresden*, 1837 to 1862.



On the *Baugewerkschule*, *i. e.*, school for masons and carpenters, being no proper part of the Polytechnic School, nor in the same building now, though under the same principal, (Professor Hülse,) see below.

From 1852 to 1866 the closing examination in the Polytechnic School was attended by 246, 12 of whom received no testimonial. Of the 234, there belonged 70 to the Mechanical School, (A;) 117 to the Engineering School, (B;) 18 to the Chemical School, (C;) 29 to the section for teachers, (D.)

Though the three academies in Dresden, Freiling, and Tharand come next in rank, the

#### IV.—HIGHER INDUSTRIAL SCHOOL AT CHEMNITZ

deserves a place here as being nearest related to the Polytechnic School, though not having so high an aim. Founded in 1836, and having *four* courses, (classes,) of one year each, its object is to prepare for a technical or agricultural career, and may be compared to the general course of the Polytechnic School; but it has two classes below the required attainments of the lowest class there, and wants the two highest classes of its professional department. Hence the pupils are admitted when 14 years old, instead of 16, and the graduates of the Real Schools enter at once the second class, omitting the two lowest ones. To show the importance of this school even to the lower classes, we mention that of 18 boys who left the third class, *i. e.*, the second from below, five devoted themselves to agriculture, two to dyeing, one, respectively, became *appreteur*, cotton-spinner, constructor of machines, miller, brewer, merchant, and apothecary; one went to a Polytechnic School, and of two the profession chosen was not known.

The pupils are either full scholars or pursue only single branches of instruction. Full scholars have to pay 24 thalers annually; partial scholars pay 2 thalers for any one-hour lesson a year; if they attend three or more different lessons also, 24 thalers in all. The expenses for books amount to 12–15 thalers a year. There were in the last year 225 pupils, and, besides the principal, Prof. Bottcher, 18 teachers, 5 of them with the title of professor. It is a Royal School, and received, in 1862, 10,000 thalers from the state, (Home Department.)

#### 2.—*Organization of Studies.*

The school is divided into several sections, according to the profession chosen by the pupils.

SECTION A.—*a.* For Mechanical Engineering.

SECTION A.—*b.* For Chemical Engineering; *i. e.*, for sugar refining, calico printing, &c.—4 years.

SECTION B, for any Chemical business without the application of machines, as soap-boiling, dyeing, coloring, &c.—3 years. The highest class corresponding to II of A.

SECTION C, for Farming—likewise 3 years; all combined in general branches.

There is added a course of Manufactural Drawing, (*fabrikzeichnen*,) in two classes, with 25 pupils.

The studies in A and B being, on the whole line, the corresponding (see above) classes in the Polytechnic School, (the present principal of the latter was formerly principal in Chemnitz,) I shall point out here the studies of Section C, the Agricultural Section, having added that all who have passed through the course of the 3d class may, without examination, enter the lowest class of the Polytechnic School; from the 2d class they may enter the last term of the general course; from the 1st class they may enter the lowest class of the professional course, or if practical skill is proved, the second year's course of the same, but at its beginning.

#### SECTION C.—*Agricultural School.*

##### *Fourth Class or First Year :*

(*a.*) Common to all sections of that class.

1. *Arithmetic*, 6 hours.—With *Hofmann's Aufgaben*, 1 and 2 parts; the four rules; interest; chain rule; involution; extracting square and cube roots; algebraic fractions; equations with one unknown quantity.

2. *Geometry*, 4 hours.—Lines; angles; area of regular polygons and of circles; equality and proportion of surfaces; contents of figures.

3. *Natural Philosophy*, 6 hours in summer, 4 in winter.—With *Ensmann's Elements of Physics*. General introduction—climatology, doctrine of heat, magnetism, and electricity.

4. *Drawing*, (free-hand exercises,) 6 hours.—From geometrical bodies, plaster models, (method of *Dupuis*,) with pencil or chalk, chiefly in outlines.

5. *Geometrical Drawing*, 4 hours —Plain drawing, as preparing for projecting and mechanical drawing; exercises in painting, with India ink.

6. *German language*, 4 hours.—With *Gotzinger's Grammar*.

(*b.*) Agricultural School.

7. *Natural History*, 4 hours in summer.—Botany, with particular regard to such plants as are important to common use; outlines of the physiology of plants. In winter, zoology, with outlines of anatomy and animal physiology, (*mammalia*.)

##### *Third Class or Second Year :*

(*a.*) With all sections.

1. *General Chemistry*, 8 hours.—Inorganic chemistry; organic chemistry; elementary analysis of organic bodies; the more important vegetable and animal matter, as fibre, starch, sugar, organic acids and bases, oils, colors, bones, flesh, sugar, urine, etc. and their products of decomposition, (fermentation, distillation, etc.) their quality and use; their relation to living vegetable and animal bodies.

2. *German*, 4 hours.—Two of these are grammar, and two oral and written exercises, alternating with reading of dramatic pieces.

(*b.*) Agricultural section.

3. *Arithmetic*, 2 hours.—Equations, with several unknown quantities; equations of the second degree; logarithms; arithmetical and geometrical progressions; interest on interest, etc.

4. *Geometry*, 2 hours.—Plain trigonometry; stereometry.



5. *Natural Philosophy*, 2 hours.—Solid, liquid, and aerial bodies; acoustics; optics.

6. *Botany*, 4 hours in summer.—With particular regard to such wild-growing plants as are important for agriculture, with excursions.

7. *Zoology*, 2 hours in winter.—With particular regard to useful and injurious animals.

8. *Mineralogy*, 4 hours in winter.—Crystallography; physical and chemical qualities of minerals in general; physiography of minerals, with particular regard to such as are the component parts of the mould, (soil.)

9. *Knowledge of machines and technology*, 4 hours in winter.—Description of the chief motors and parts of machines, and of the manufacturing in wood and iron.

10. *Mechanical drawing*, 4 hours in summer; in winter, 2 hours.—Brief description of parallel projection; drawing of agricultural utensils and machinery.

11. *Practical Geometry*, (surveying.)—In summer, one afternoon, in several divisions, each consisting of 5-6 pupils.

12. *Mercantile Arithmetic*, 2 hours in summer.—Explanation of the Leipsic Exchange List (*courszettel*;) calculations of interest, of stocks and shares, invoice, &c.

13. *Book-keeping and Correspondence*, 2 hours in summer, 4 hours in winter.—Theoretical and practical with regard to business concerns occurring on a farm of middle size, and to brewery, distillery, &c., besides topographical drawing, belonging to 10, combined with the II class of section A.

*Second Class or Third Year, and last in this section:*

(a.) With all sections.

1. *German Language and Literature*, 4 hours.—Two of them in history of literature; one in oral and written exercises, with records; one in popular logic and rhetoric.

(b.) Agricultural section.

2. *Physiology of Plants*, 4 lessons in summer.—Anatomy of cultivated plants explained by microscopic illustrations; general ph. of cultivated plants; influence of soil and climate, etc.; doctrines of soil and manure; watering and draining; raising and propagating of plants; crossing; varieties, etc., with practical exercises. In winter—special physiology of plants; systematic description of the cultivated plants and of the best methods of cultivating them.

3. *Physiology of Animals*, 2 lessons in summer.—Anatomy of domestic animals. In winter 4 hours—general physiology of domestic animals; cattle breeding; the plastic process; excretion of milk; the functions of nerves and muscles; special physiology of domestic animals; the specific qualities; the production of flesh, milk, fat, wool; muscular power with regard to feeding; the hoof of the horse; diseases of animals; practical exercises.

4. *Farming*, 4 hours.—Principles of rural economy; capital and labor, etc.; requisites of farming; organization and management of a farm; buildings, utensils, manure; cattle breeding; agricultural book-keeping; agricultural valuation.

5. *Agricultural Architecture*, 2 hours.—Making of bricks, pipes, air and water cement, burning of lime, etc.; best construction of buildings, barns, stables, etc.

6. *Practical Geometry*, 1 afternoon in summer—surveying of larger grounds. In winter—theory of field surveying.

7. *Geognosy*: 2 hours in summer, with excursions.

8. *Agricultural Chemistry*, 4 lessons in summer, 2 lessons in winter.—Inorganic and organic chemistry reviewed and completed, with particular regard to agriculture.

Besides, there are—

*Chemical Exercises* with other sections, 4 in summer and 4-8 hours in winter.

*Technical Chemistry*, with section B, in 2 hours; especially on manufacturing of starch, sugar, vinegar, or brewing, distilling, etc.

All pupils of the Industrial School have opportunity to learn *French*, in 5 classes, 3 lessons a week; *English*, in 4 classes, 3 lessons a week; *history* and *geography*, 14 hours for the 4th class, which all pupils must attend who enter not sufficiently prepared in these subjects.

Joined with this school, and therefore to be mentioned here, is the so-called—

3.—ROYAL WORKMASTERS' SCHOOL.

(Formerly in Freiberg; for the last 15 years in Chemnitz.)

It has in view to train millwrights, makers and inspectors of wells and water-works, as well as foremen in engine factories and spinning-mills.

The journeyman-pupil, on admission, must be at least 16 years old, and have worked two years with a master, and produce a testimonial from him.

The course, consisting of three half-year classes, commences on the first of October and ends at Easter of the second year—18 months. The pupil has to pay six thalers for six months; and poor and worthy pupils of the school may, as in other schools, pay nothing at all. Books and stationery cost about ten thalers per annum. The number of scholars amounts to 82, with 10 teachers, one of whom, with the title of professor, particularly belongs to this school. It received, in 1862, an annual supply from the state of 1,450 thalers.

The plan of lessons is:

	III. 1st H. Y.	II. 2d H. Y.	I. 3d H. Y.
Arithmetic.....	7	—	—
Mathematics and mechanics, (logarithms, plane trigonometry, statics).....	—	8	—
Mechanics.....	—	—	4
Geometry, (stereometry).....	5	—	—
Surveying, (measuring of field and water).....	—	4	—
Geometrical drawing and projection.....	8	—	—
Natural philosophy and chemistry.....	4	2	—
Ornamental drawing.....	4	—	4
Architectural drawing.....	—	4	—
Mechanical drawing..	—	8	8
Construction.....	—	2	6
Mechanical technology.....	—	4	—
Construction of mills, (for millers).....	—	2	2
Spinning and weaving, (for the respective journeyman-pupils).....	—	—	4
Construction of pipes and wells, (for conduit-masters).....	—	—	4
German.....	4	4	—
Book-keeping.....	—	—	2

The Royal *Workmasters' School in Chemnitz* has had from 1855 to 1866, in all, 326 pupils, of whom there were 206 from Saxony, (25 *Chemnitz*;) 55 from Thuringia, 59 from Prussia, 8 from Schleswig-Holstein, 8 from Austria, 5 from Russia, 4 from Anhalt, 5 from Wurtemberg, 3 from Lubeck, 2 from France, 1 from Bavaria, 1 from Bremen, 1 from America. Of these 326, there were 239 constructors of machinery, and iron workmen in general; 52 constructors of mills, mill-



wrights and millers; 17 spinners, weavers, and *appreteurs*; 18 of various trades, as watchmakers, cabinet-makers, founders, tinkers, girdlers, copper-smiths, masons, stocking-manufacturers, gardeners, &c.

The full course has been passed by 157 pupils.

There is joined one more school to the Royal Industrial School at Chemnitz, a so-called

#### 4.—BAUGEWERKENSCHULE.

(*Architectural School for Masons and Carpenters.*)

There are five such schools in Saxony, one of them mentioned as being under the same management as the Polytechnic School at Dresden, another joined to the Academy of Arts in Leipsic, and two independent ones in Plauen and Zittau. This seems to be the proper place to speak of this class of schools.

These schools are intended to train good carpenters and mason masters, and require for admission the beginning of apprenticeships at least for six months.

The course embraces the time of three winters, (in Leipsic of two,) so that in summer the pupils work with their master; only in Leipsic and Zittau there is a summer course established for more advanced students. The number of pupils in all five schools was, 1865–1866, 548; (in Chemnitz, 109; in Zittau, 149, &c.) In Leipsic the average number in winter is 88; in summer, 25–30.

The expenditure for these schools by the Home Department is, annually, 7,550 thalers; (for Leipsic, 1,850 thalers.) On the average, the winter-course term of a pupil costs 21 thalers, of which  $17\frac{2}{10}$  are paid by the state, and  $3\frac{8}{10}$  by the pupil. The proper pay of the pupil is 5 thalers for the term of six months.

Of the 736 pupils who attended the school in Dresden in the first 25 years, (1837–'62,) there attended 191 during one winter term, 200 during two winter terms, 250 during three, 90 during four, and 5 during five.

Most of the students repeated the third course, and some, by compulsion, the first or second course.

Of the 117 pupils last winter in Dresden, there were 87 masons, 28 carpenters, and 2 stone-cutters; of whom 51 were journeymen, and 66 apprentices.

Of the ten teachers in Chemnitz, (seven in Leipsic and Dresden,) one professor is exclusively employed in this school; another professor, common to this and the Workmasters' School, and the rest employed in the Home Industrial School.

The plan of studies in Chemnitz is as follows :

	III.		II.		I.	
	First	W. T.	Second	W. T.	Third	W. T.
Arithmetic, (quadratic equations) .....	7		—		—	
Geometry, (stereometry) .....	5		—		—	
National philosophy.....	4		—		—	
Mechanics .....	—		4		2	
German language.....	4		2		2	
General architecture.....	4		2		—	
Architectural drawing.....	6		4		4	
Ornamental drawing.....	2		4		4	
Projection .....	4		2		—	
Embossing in clay.....	—		—		3	
Modelling.....	—		—		3	
Perspective.....	—		2		2	
Masonry, } respectively.....	—		4		—	
Carpentry, }	—		4		—	
Construction, (continuing the course on ma- sonry.).....	—		—		4	
Designing of architectural plans.....	—		6		8	
Estimating of the costs.....	—		—		2	

There is an examination at the close of each winter term, when the pupil may get a testimonial from the school of his attainments, in order to be admitted to the examinations for masters of architecture.

The plan of studies in the summer term at Leipsic is :

1. Architectural drawing, 12 lessons a week.
2. Drawing, (free-hand practice,) 4 hours.
3. Linear perspective, including construction of shades, &c., 4 hours.
4. Architectural style of middle ages, 4 hours.
5. History of architecture, with regard to masons and carpenters, 4 hours.
6. Reviewing exercises in construction, 4 hours.
7. Trigonometry and higher equations, with application to architecture, 4 hours.
8. Guidance to solving problems of arithmetic and construing geometry, 4 hours.
9. Doctrine of trade, including laws of exchange, 2 hours.
10. German orthography and compositions, exercises in field-surveying, 4 hours.

According to the prospectus of the school in Leipsic, an appropriate preparation is obtained in this school for such as wish to continue their scientific-technical or artistic-architectural, either in the Polytechnic School or in the Academy of Arts at Dresden.

The Royal Committee of Examination for such architects as are trained in the Workmasters' School, *i. e.*, for master masons and master carpenters, (*bauhandwerker*,) consists in Dresden of eight members, one of whom is a member of the municipality, (who presides;) one the chief professor of the Workmasters' School; one a master mason; one a master carpenter, with as many substitutes.

*Second Winter Term :*

1. The simple principles of mechanics, with the application of the same to architectural subjects, with exercises, 6 hours.
2. Doctrine of construction of buildings in their stone, wood. and iron parts, 6 hours.



3. *Agricultural architecture*, 4 hours.
4. *Architectural drawing*, with exercises in projecting ground-plans, 2 hours.
5. Doctrine of making estimates of costs, with an instruction in architectural law, 4 hours.
6. *German*, embracing correspondence with private persons and magistrates; compositions and free discussion, 4 hours.
7. *Book-keeping* and laws of exchange, 2 hours.
8. *Modelling and embossing in clay*, 4 hours.

Practical instruction in the *Baugewerken* does not come within the purpose of the institution, yet, as far as is possible in the limited time, there are modelling exercises for masons, carpenters, and stone-cutters in the workshop of the Institution during the free time and on Sundays.

The proper course of two winter terms in Leipsic is as follows, (lessons, 8-12 and 2-6:)

*First Winter Term:*

1. *Arithmetic*, including the elements of algebra, 6 hours a week.
2. *Descriptive Geometry, Stereometry, and Rectangular Trigonometry*, 4 hours.
3. *General Architecture*, as introductory to the subject of building materials and implements, as well as the purposes, parts, arrangements, requisites, and deficiencies of buildings, 6 hours.
4. *Drawing*, both free-hand and geometrical drawing, projections, with the principles of the construction of shade, from models and papers, 8 hours.
5. *Architectural Drawing*, for learning the needed manual skill in drawing the different parts of a building and constructions from papers, and after a given scale, 12 hours.
6. *Architectural doctrine of forms*, or drawing of the most important arch forms, (styles,) with illustrations on the black-board, 4 hours.
7. *German language*, 4 hours.
8. *Modelling and embossing in clay*, 4 hours.

V.—THE HIGHER WEAIVING SCHOOL AT CHEMNITZ.

1.—*History and Object.*

The Higher Weaving School at Chemnitz was founded in 1857, and was so prosperous that the town of Chemnitz, assisted by the state, erected, in 1865, a large and convenient building for the same, at a cost of 26,037 thalers, the interest of which at the rate of 6 per cent., (1,562 thalers,) to be paid by the school to the town, (for which the latter is bound to keep it in order,) has been guaranteed, and thus far paid by the Minister of the Interior. Before that time the state had given an annual grant of 500 thalers, of which 260 thalers were expended for the hired rooms, so that 240 thalers remained for the expenditure of the school, which now must be brought up by the income from tuition fees.

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Documents relating to this School.

1. The Higher Industrial School at Chemnitz, programme of 1867, containing a report on the Workmaster School and on the Architectural School; 2. Prospectus of the same, in German, 1867; 3. Prospectus of the Workmasters' School, 1867; 4. *Mittheilungen über die Baugewerkschule von 1837, bis 1862*, pp. 14; 5. Annual reports on the same in the Programmes of the Polytechnic School, [twelve;] 6. Plan of lessons in the *Baugewerkschule* at Leipsic, [written in German,] 1867-1868; 7. Prospectus of the same, [do.,] 1867-1868; 8. School laws in the same, [do.,] 1867-1868.

The annual expenditure amounts to 3,000 thalers. The pupil has to pay for the full year's course 90 thalers; for six months, 60 thalers. For patterns and the necessary weaving material he has to pay, for six months, 10 thalers in advance; if more be needed in that time, he has to supply the remainder. But the woven clothes the student receives as his property at the end of the course.

The Directory consists of a member of the municipality, (at present the president, Adv. Schmidt,) of a professor of the Royal Workmasters' School, and two proprietors of weaving factories.

The institution is intended to train, by scientific instruction and practical exercises, workmasters and manufacturers for all kinds of weaving, as well as to impart to young men who will devote themselves to the manufacturing trade, either as buyers or sellers, an accurate knowledge of manufacturing, and thus the ability of estimating the merchandise.

For this purpose the school has—

a. One shaft-room, with 22 hand-loom, and all auxiliary machines for spooling, shearing, &c.

b. One Jacquard-room, with 16 Jacquard machine-loom, and 2 machines for stiffening by gumming, (*kartenschlag*), spooling-wheels, chenille machines, &c.

c. One machine-room, with a steam-engine and boiler; seven looms (*kraft*) of English and German construction—some with Jacquard machines; one hand-weaving loom; one spooling machine, and one beam-loom (*baum*)—all this worth about 4,000 thalers.

There were in the last summer term thirty-three pupils (seventeen foreigners) and four teachers, with one master-weaver assisting in the practical exercises.

## 2.—*Course of Instruction.*

The course of instruction one year, in two terms and classes. Instruction is given from 8 to 12 A. M., and 2 to 4 P. M. daily, four times a week. Each lesson is at least of two hours; in the morning, generally of four continuous hours

*First term, (of six months :)*

1. Lectures on weaving material, two hours
2. Lectures on construction and systems of the various hand-weaving looms, and of the auxiliary implements, two hours.
3. Free-hand drawing, (outlines, designing of patterns,) and chromatics, (doctrine of colors,) four hours.
4. Analysis (*decomposition*) of pattern, making of cartoons, and calculation of the respective stuff for hand and Jacquard weaving, with the appropriate instruction in "*appretur*" (finishing) and its machines, eighteen hours.
5. Exercises in shaft weaving, six hours.

*Second term, (class :)*

1. Composition of patterns for hand and Jacquard weaving, four hours.



2. Lectures on mechanic looms, and on the auxiliary machines for mechanic weaving, four hours.
3. Continuation of analysis (*decomposition*) of Jacquard stuffs, velvets, gauzes and ribbons, eight hours.
4. Drawing, four hours.
5. Exercises in weaving on looms of various construction, twelve hours.

The parents of the pupils receive quarterly *censuren*, on application, of the attainments and moral conduct of their sons.

On leaving school, after having finished the course, the student receives a testimonial. The best are honored with prizes or commendatory testimonials.

#### AGRICULTURE IN SAXONY.

The state grants for agriculture in general 20,000 thalers yearly, not including the academies in Tharand and Leipsic, which received each 16,000 thalers. Half of that sum is given to the five district associations, (*kreisvereine*,) which they have to account for in a regularly drawn up register of annual expenditure; the other 10,000 serve to pay the expenses of the experimental stations, (*Versuchsstationen*,) of the general secretary for the agricultural associations (Dr. Reuning, privy counsellor of the government) and their office, of the lectures in the associations, &c. Of the experimental stations, which were first founded in Saxony, some are kept and supported by government, as the one in Chemnitz, joined to the Industrial (Agricultural) School there, with 1,200 thalers; another (physiological) joined to the Veterinary School in Dresden with 900 thalers; others are aided directly and indirectly by government, as Pommritz, with 600 thalers; Möckern, near Leipsic, with 500 thalers. Farming schools, such as are in Wurtemberg and Prussia, do not exist in Saxony. Having a merely practical aim, to be attained by working and school instruction, the former is not considered necessary here, and the latter impracticable; likewise the supplementary schools for farming, (*fortbildungsschulen*,) which have sprung up here in the last twenty-five years, and have been partially aided by government, were, with the exception of two, given up, and left to their own resources.

Besides the Agricultural Academies,\* much reliance for promoting

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\* In the session of the Diet in 1867 it was proposed by the deputies, and as good as agreed to by government, that the agricultural section in Tharand should be separated from the academy, and probably transferred to Plagwitz, near Leipsic, in order to be connected with the university. Besides, I am reminded here of the agricultural section in the Industrial School at Chemnitz, of the Veterinary School, and mention the institution for horse-breeding (the stallion being sent thence at proper times throughout the country) in Moritzburg, near Dresden, with a state grant of 30,000 thalers.

#### Documents.

1. Prosperity of the Higher Weaving School at Chemnitz; 2. Plan of Lessons; 3. Letter from the President of the Directory, Adv. Schmidt.

the interests of agriculture is laid by the Saxon government on associations. To work through them efficiently, first, a monthly official magazine for these associations is issued, and edited by the general secretary, which has been very successful. Also, scientific lectures are held, chiefly by chemists, at the experimental stations, without having special travelling teachers employed for this purpose, as is the case in other countries. Finally, there are Agricultural Commissaries for benefiting farms, who are instructed not only to hold lectures in the associations, but also to assist the farmers with their advice. This is done by adjusting farms, by projections of draining, construction of meadows, &c. Proprietors of small farms receive this advice gratis. This institution has been of great importance, for, by it, model farms in the hands of private parties have been formed in great number, whereas the model farms founded by the government in Saxony generally did not realize the hopes.

The associations are quite independent. There are at present three hundred. These unite to form district associations, the committees of which are composed of the presidents of the former. Deputies of the district associations form the Council of Agriculture, which is a consulting board for government. Deputies of this council have to look after the interests of the schools, of forestry, natural sciences, horse-breeding, and horticulture.\* It is not necessary to add that there are frequent agricultural exhibitions in the districts and in the country.

Besides the direct and indirect aid to the agricultural interests of the kingdom, the government renders still more important help by providing schools where scientific agriculturists can be trained.

#### VI.—THE ACADEMY OF FORESTRY AND AGRICULTURE.

##### 1.—*Establishment, Organization and Admission.*

This academy was founded in 1811 by H. Cotta, and established as a state institution in 1815. The original building belonged to Cotta, and was bought for 7,000 thalers in 1845; but the present house was constructed in 1847 at an expense of 45,133 thalers.

The agricultural section was added in 1830, with 4 students, (in 1816, 62 students of forestry;) in 1837 there were 24 students of forestry and 26 of agriculture. From America there were, from 1852 to

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\* The botanical garden in Dresden has about twenty-five thousand cultivated plants, and sends away, on an average, three thousand packages of seed annually, receiving nearly the same amount. It serves as a scientific and educational institution, and is open all day to any visitor. Nearly the same may be said about the botanical garden in the university at Leipsic.

Document.

Letter from the General Secretary of Agriculture, Dr. Reuning.



1865, 24 students—14 of forestry and 10 of agriculture; from England, none of forestry, 14 of agriculture. On the average, there have been admitted in the summer 28 students, (15 Saxons,) and in the winter, 15, (3 Saxons.)

H. Cotta died in 1844. The present principal is J. Fr. Judeich, to whom we are indebted for a presentation copy of the *Tharander Jahrbuch* of 1866. The principal of the agricultural department is Dr. Schober; the administration of general affairs, however, is always entrusted to the principal of the forest department. Schober, since 1852, in Tharand, has written the history of the academy to be found in the above-mentioned book, which was published at the semi-centennial anniversary.

The grounds belonging to the academy (forest of Tharand, a botanical garden, and the farm) cover an area of 10,928 Saxon acres. The library consists of 670 books on forestry, 70 on huntsmanship, 719 on agriculture, 31 on horticulture, 85 on veterinary science; the rest on other sciences, with 65 periodical publications on forestry, 91 on agriculture, &c.

The collection for foresters contains 132 different instruments and a technological collection of 390 pieces; for huntsmanship, 63 plaster-tables, with game tracks, and a well-arranged shooting stand. The agricultural collection has 90 utensils and machines, 98 models, 18 sorts of apparatus, not to mention the botanical, zoological and mineralogical collections of all kinds. The physical cabinet contains an apparatus of 112 ph. machines.

In the budget of 1864–1866, the annual expenses were estimated at 14,850 thalers, to which the state (the two academies in Tharand and Freiberg belong to the financial department) granted 13,650 thalers per annum, expecting an income from the students of 1,200 thalers.

The expenses were, in thalers, (three English shillings:)

10,150 for salaries, 950 for the library, 250 for the gardens, 900 for the chemical laboratory, 350 thalers to poor students, 600 for the buildings, 200 for the furniture, 110 for printing, &c., 370 for excursions, 50 for experiments in the woods, 320 for fuel, light, &c., 100 for aiding scientific travels, 500 for agricultural experiments.

With the two principals, who are the first professors in their respective departments, there are thirteen teachers, seven of whom bear the title of professor, and six other inferior officers, with ninety-one students in 1866.

Every student in either department has to pay, if a Saxon, 50 thalers yearly; if not, 75 for the whole instruction, besides an entrance fee of 10 thalers, (Saxons, 6 $\frac{2}{3}$  thalers,) and 3–15 thalers for the use of the

laboratory during a “*semester*” or six-months’ term. There are six free scholars, six half-free, with stipends, though not as large as in Leipsic, but sufficient for the limited number of students, who also, generally speaking, are less dependent. These stipendiaries receive from 20 to 50 thalers per annum. Some riflemen of the royal army, if they be practically prepared at least for one year in the service of a forester, may be admitted as free scholars and receive some aid for board and fuel. As in all schools which are supported by the state, the tuition fee may be remitted to any poor student.

On admission, each student must be at least seventeen years old; and so far prepared as to be benefited by the lectures. It is desired that the aspirants should work one year before entering on a farm or with a forester. Saxons, who wish to be royal officers of the forest, have to produce a testimonial of maturity from a gymnasium, or from the Industrial School at Chemnitz, or from a real school; in the last case with a good mark in mathematics. They must also have worked one year with a forester.

#### 2.—*Course of Studies.*

Instruction in either section is divided into two annual courses, which must have been completed by such as want to be officers of the forests. The professors “keep themselves in perpetual intercourse with the students, and superintend their study hours and general conduct.” After each *semester*, summer or winter term, the students receive *censuren*. The Saxons are required to pass an examination at the same time.

The plan of studies for both sections during the two courses has been, since 1857, as follows, (Schober, 1866, p. 98:)

	<i>First Year.</i>	<i>Second Year.</i>
Mathematics for foresters.....	6 h. in s.	—
Mathematics for agriculturists.....	2 in s.	—
Measuring for foresters.....	2 in w.	1 aft'n in s.
Measuring for agriculturists.....	1 in w.	1 aft'n in s.
Special mathematics for foresters.....	2 in w.	—
Mechanics for both sections.....	—	2 h. in w.
Architecture, specially for agriculturists.....	—	2 in w.
Architectural drawing.....	3-4, s. & w.	3-4, s. & w.
Natural philosophy.....	3 in w.	—
Meteorology.....	—	2 in w.
Chemistry, general, with technology.....	4 in s.	—
Agricultural chemistry (doctrine of soil).....	4 in w.	—
Chemical exercises.....	—	2 aft'ns in s. & w.
<i>Natural history :</i>		
Mineralogy.....	5 h. in s.	2 aft'ns in s. & w.
Min. excursions.....	2 in s.	—
Geognosy.....	—	3 h. in s.
Botany, general.....	3 in s.	—
Physiology of plants.....	—	3 in s.
Botany for foresters.....	—	2 in s.
Review of natural history.....	—	1 in w.
Excursions.....	1 afternoon in s.	—



	<i>First Year.</i>	<i>Second Year.</i>
Zoology.....	3 h. in w.	—
Entomology, (general doctrine of insects).....	1 in s.	—
Entomology for foresters.....	—	3 in w.
Entomology for agriculturists.....	—	2 in w.
<i>Science of forestry :</i>		
Outlines.....	3 in s.	—
Protection of forests ( <i>forstschutz</i> ).....	2 in w.	—
Administration of hunting grounds ( <i>jagdverwaltung</i> )..	1 in w.	—
Cultivation of woods.....	—	3 in s.
Improvement of forests, with technology .....	—	3 in s.
Management of forests.....	—	2 in w.
History of forestry and huntsmanship, with literature.....	—	2 in w.
State forest economy, with the principles of political economy.....	—	2 in w.
Exercises in valuation.....	—	4 in s.
Practical exercises.....	{ 1 day in s. 4-6 h. in w.	—
<i>Science of agriculture :</i>		
Encyclopædia.....	1 in w.	—
Agricultural physiology of plants.....	4 in s.	—
Cattle breeding.....	3 in w.	—
Political economy.....	—	4 in s.
Management of farms.....	—	3 in w.
Agricultural excursion.....	{ 1 day in s. 4-6 h. in w.	—
<i>Veterinary science :</i>		
Exterior or good points of domestic animals .....	2 h. in s.	—
Anatomy of domestic animals .....	2 in w.	—
Physiology " " .....	—	1 h. in w.
Diseases " " .....	—	2 in s.
Regimen (care of health) of domestic animals.....	—	2 in s.
Shoeing of horses.....	—	1 in w.
<i>Horticulture :</i>		
Cultivation of fruits and vines.....	—	2 h. in s.
Cultivation of vegetables.....	—	2 in w.
Science of the law for both sections.....	—	3 in w.

3.—*Examination.*

At Easter there is an examination for such as wish to leave the academy as graduates, with a testimonial. All who wish to be royal officers have to pass the full examination, which embraces two compositions written in the last winter term on a subject chosen by the student and on another given by the principal. Then they have to show their skill in drawing by producing topographical and other forest plans, or an architectural or mechanical drawing and the design of a plan; then on each branch to answer dictated questions, written within a certain time in presence of two professors; and if their writings have been approved, to pass an oral examination in mathematics, botany, physiology of plants, zoology and entomology, mineralogy and geognosy, physics and meteorology, chemistry and doctrine of soil, science of forestry or agriculture. Three *censuren* are given, besides those for application and moral conduct, in sciences—"excellent," "good,"

“sufficient.” The third or last *censur*, however, is not sufficient for being admitted to the state examination, but they are allowed for that purpose to pass again the above-mentioned examination after a third year’s course in the academy. “Volunteers,” as foreigners or Saxons who want no employment, may pass the full examination, or, if they choose, be examined in single branches, in which they desire to have a testimonial of the academy, according to the *Regulative* for the said examination published in 1853.

#### VII.—THE AGRICULTURAL ACADEMY IN PLAGWITZ, NEAR LEIPSIC.

##### 1.—*Statistics.*

The Agricultural Academy in Plagwitz was founded in 1851, in Lutzschena, 10 English miles from Leipsic, but, in 1861, was transferred to Plagwitz, in the vicinity of Leipsic, and constituted there as a part of the university. Most teachers are professors in the university, and the students have to attend in both lecture-rooms at Plagwitz and Leipsic, distant 25 minutes. The present principal is Professor Birnbaum.

The farm consists of 483 Saxon acres=1,086 Prussian acres, and is the property of Dr. Heine, a rich gentleman, who, by cultivating the grounds and covering them with buildings, has nearly joined Plagwitz to Leipsic. The liberal offer of that farm for the purposes of an agricultural academy was accepted in 1861 by the government. There are on the farm a tile kiln, a steam brewery, and near it a manufactory of agricultural machines and utensils.

The annual expenditure is 5,980 thalers, to which the state grants as yet but 1,000 thalers.

The number of students since 1851 has been on the average 46 per annum; in all, 79 from Saxony, 105 from Prussia, 43 from Bohemia, 48 from Russia, (36 of whom are from the German Baltic provinces,) &c. At present there are 38 students.

The whole course embraces three semi-annual terms; but for those who are insufficiently prepared a preparatory half-year’s course in Plagwitz is added. A certain age is not required, but it is desired that the student be at least 18 years old, and should have spent at least six months on a well-managed farm.

The pay for the preparatory course in Plagwitz is 60 thalers for the following courses: 15 thalers for the *semester*, besides the different

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##### Documents.

1. *Tharander Jahrbuch, (Festschrift)*, 1866, pp. 478, containing a history of the academy by Dr. Schober; 2. General Plan of the Royal Academy in Tharant, 1862; 3. Laws of Discipline; 4. Plan of Studies, 1867-1868; 5. *Regulative* for the last examination, 1853.



fees to be paid to the professors of the university; from 2–5 thalers for a branch of instruction, and 10 thalers for the chemical exercises.

### 2.—*Course of Studies.*

The preparatory course in Plagwitz is as follows :

- General agriculture, 4 hours, by the principal.
- History and literature of agriculture, 2 hours, by the principal.
- Inorganic chemistry, 4 hours, by Dr. Heppe.
- Exercises in the laboratory, 8 hours, by Dr. Heppe.
- Mineralogy and geognosy, 2 hours, by Dr. Heppe.
- Anatomy and morphology of plants, 2 hours, by Dr. Frank.
- Anatomy of domestic animals, with good points of horses, and shoeing, 4 hours.
- Book-keeping, 2 hours.
- Surveying, on Saturday a. m.
- Practical agricultural exercises, Saturday, p. m., by the principal.

Besides, a *conversatorium*, *i. e.* a conversational drill, on Thursday evening, with all the students and with friends of agriculture, on agricultural questions, exercises, and excursions, when the principal is assisted by several teachers.

The regular course at Plagwitz and Leipsic is :

#### *First term, (of six months :)*

1. Cultivation of plants, (soil, manure, meadows, &c.,) 4 hours.
2. Doctrine of soil, with valuation, 2 hours.

#### *Second term :*

1. Cattle breeding, with knowledge of wool, &c., 4 hours.
2. Feeding cattle, (expenditure.)

#### *Third term :*

1. Doctrine of managing farms, (balance between exhaustion and compensation of fields, meadows, &c.,) 2 hours.
2. Valuation of crops, (for buying farms or having them to rent, or, in case of employment, for making estimates in due form,) 4 hours.

This last and most important division combines a review of all the subjects before treated.

All these lectures on agriculture are given by the principal.

The auxiliary sciences may be studied in lectures at the university, viz, on—

- Political economy, 4 lectures weekly, by Prof. Roscher.
- Agricultural chemistry, 2 lectures, by Prof. Knop.
- Exercises in the Agricultural Laboratory in Leipsic, conducted by the same professor and two assistants, (hours *ad libitum*.)
- Experimental philosophy, 3 lectures, in winter, by Prof. Zöllner.
- Meteorology, 2 lectures, in summer, by Prof. Zöllner.
- Physiology of feeding, 4 lectures, by Dr. Huppert.
- Botany, with excursions, 3 lectures, by Dr. Frank.
- Physiology of plants and use of the microscope, 4 lectures, by Dr. Frank.
- Technology, 4 lectures, in winter, by Dr. Heppe.
- Regimen of domestic animals, 4 lectures, in summer, *privatim*, and on other general branches, such as mechanics, mathematics, chemistry, zoölogy, &c., by other professors.

### 3.—*Examination.*

There is at the end of each term an examination, (according to the

statutes sanctioned by government,) to which all are admitted who apply for it after having studied in the academy at least two terms—one year. Before the examination the candidate has to solve accurately a problem in writing at home, but must solemnly declare that it has been done without the help of others. Then he has to answer, in the presence of professors, also in writing, two questions of less compass than the one above mentioned. The oral examination embraces also agricultural science and the auxiliary sciences, of which, however, the student may choose two himself. It lasts two hours and a half. The pay for the examination is 10 thalers, to be half remitted in case the candidate does not succeed.

MINING AND MINER'S SCHOOLS.

VIII.—THE MINING ACADEMY IN FREIBERG.

1.—*History and General Observations.*

The Mining Academy at Freiberg was established in 1766. Its founders and benefactors were Von Heynitz, afterwards Prussian Minister, and Von Oppel, President of the Mining Department. Of the seven presidents who succeeded Mr. Oppel, the three last may be mentioned above all: Herder, 1819–1838; Freiesleben, 1842; and Von Beust, brother of the well-known Austrian Minister, who now leaves his place to accept a similar position in Austria.

The chief office for all miners (the *Oberbergamt*) in Freiberg, under the control of the Secretary of the Treasury, consists of a board of directors of the mines in Saxony, (*Oberberggräthe*), and has, besides the superintendence of all mining affairs in Saxony, the direction of this academy, so that the president of that board (*Oberberghauptmann*) is at the same time the chief director of the academy.

To the names of the presidents to whom the academy is much indebted for its prosperity there may be added from the great number of professors the name of one, the centennial anniversary of whose birthday was celebrated by the academy in 1850, viz, A. G. Werner, professor, 1775; died, 1817. Other celebrated names, together with the titles of what they have published, may be found pp. 1–43 of the “History of the Academy.”

The grant for the first establishment amounted to no more than 1,400 thalers, 1,000 of which were expended for Oppel's library and collections. The expenditure of the year 1766 amounted to 1,535 thalers: 470 for instruction; 623 for library, collections, inspection; 400 for

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Documents.

1. The Agricultural Academy in Plagwitz, Leipsic, by Prof. Birnbaum, pp. 72. 2. Written communications on the expenditure. Statutes.



stipends, (free scholarships;) 40 for prizes; but in 1867 the expenditure amounted to 16,567 thalers, (10,278 for instruction and inspection; 3,187 for the library, &c.,) 4,567 being the income of the academy, so that the state had to add 12,000 thalers.

In 1765 the academy was lodged in Opper's house, consisting of three hired rooms on the ground floor, viz, one lecture room, a cabinet of ores, and a room for books and models. In 1792 the house was bought for 4,000 thalers. This same house is to this day the academy building, but renewed and enlarged by adding the neighboring houses: 3,526 thalers for a laboratory in 1797; 6,000 for a house and its adjoining in 1818; 1,950 for a house in 1835; 27,280 thalers for demolishing the last mentioned house and a part of the old one, and for building on their place a new one; 18,516 for enlarging the building in 1857; 8,120 for the metallurgical laboratory in 1862; 9,234 for a chemical room in the same year. It is, however, agreed that a new building on an open place would have better served the purpose than the present arrangement, especially since the light has been obstructed by a large house raised on the opposite side in spite of all offers made to the owner of the grounds by the state.

The library and the fifteen collections are valued at 125,000 thalers; the library at 30,000; the classified collection of minerals, one of the five, 35,000; Werner's Mineral Museum, 18,000; for geognosy, 6,000; fossils, 4,500; for geography, 5,000, &c. It may be worth mentioning that the academy has also a sale collection of saleable minerals as old as the academy itself, not originally intended as a source of income, but valued as a means of intercourse and commerce with other countries, and for showing the students the best way of making collections. The name of the present administrator of the sale-room is R. B. Wappler.

There were, in 1866, 13 professors with 51 students. Since its establishment in 1766, 1,225 students from Saxony; 782 students from Germany, without Saxony; 326 students from Europe, without Germany; 132 students from America, &c.; total, 2,465 students.

The students are in part supported by the state, who must be Saxons, and are expected to accept no employment in any other country, or if they do, to return the pecuniary aid they may have received. They have to pay, besides, a matriculation fee of 3 thalers, 6 thalers for the practical course, and for academical instruction 50 thalers annually, of which any poor student may get, except in the first year, an abatement or the allowance to pay it later, besides receiving money from the stipend funds; or such as study at their own expense have to pay 6 thalers when matriculated, and about 47 thalers annually to the academy, and

the different fees paid to the professors for the lectures and exercises, viz, mathematics, 20 thalers; geometry, 20; assaying, 30; mineralogy, 25; theoretical chemistry, 25; practical chemistry, 30, &c., annually.

For admission, the aspirant must be at least 16 years old, and bring good testimonials of conduct. The former class of students (Saxons) must have a testimonial of graduation from a gymnasium, or the general course of the Polytechnic School, or the Industrial School in Chemnitz, or a Real School; in the last case, as in Tharand, the student must have a good grade in mathematics; if not, he has to undergo the examination for admission. Those who study at their own expense must produce, as the general expression is, proofs of satisfactory preparation for academical studies.

The Saxon students are required to wear the prescribed mining dress.

#### 2.—*Plan of Studies.*

The course begins on the first Tuesday in October, and ends with the last week of July. The full course is not limited, but usually embraces from three to four years.

The different branches taught by lectures and exercises are—

1. Mathematics, (cubic equations, trigonometry, analytical geometry,) 4 lectures a week.
- b. Elements of differential and integral calculus, and the principal part of higher mechanics, 4 lectures.
2. Descriptive geometry, 4 lectures.
3. Elementary mechanics, in 2 courses: *a*, general, 4 lectures; *b*, mining mechanics, 3 lectures.
4. Theory of mining machines: Construction, *a*, general, 2 lectures; *b*, special, 4 lectures.
5. Surveying of mines, (*markscheidekunst*;) *a*, general, 2 lectures; *b*, practical, 5 lectures.
6. Chemistry: *a*, theoretical, 4 lectures; *b*, practical, 4 lectures; *c*, analytical, 4 lectures.
7. Metallurgy: general, 4 lectures.
8. Science of foundries, (*eisenhütten*;) 2 lectures.
9. Assaying, (*probirkunst*;) *a*, dry, 6 lectures; *b*, practical, 15 hours; *c*, liquid, 2 lectures.
10. Use of the blow-pipe, 2 lectures; exercises, 4 hours.
11. Mineralogy, 5 lectures; exercises, 2 hours.
12. Crystallography, 1 lecture.
13. Physics, 4 lectures.
14. Geology, 5 lectures.
15. Science of fossils, 2 lectures.
16. Science of the layers (or beds) and veins of ore, (*erzlagerstätten*;) 2 lectures.
17. Science of mining: *a*, 5 lectures; *b*, 5 lectures.
18. Architecture, civil, 3 lectures.
19. Rights and laws of mining, } 4 lectures.
20. Commercial style for miners, }
21. Book-keeping, 2 lectures.
22. Drawing, 14 hours.
23. French, 4 lectures.
24. Chemical technology, 1, (*privateur*.)
25. History of architecture, 2, (*private*.)



The Monday of each week is chiefly devoted to descending into the mines, visiting the smelting houses, to geological excursions, &c.

### 3.—*Examination.*

The theoretical instruction is, as in the university, given by lectures, and the student has the choice. The Saxon students have to pass an examination at the close of each year, and to present their journals or day-books, in which they are required to register, during the whole study-time, their observations on theoretical and practical subjects.

The students who wish to get a public employment in Saxony must pass a state examination, in which no more than three students at once are examined before a board of examiners, consisting of the president of mining affairs, of one counsellor of the *Oberbergamt*, one of the *Oberhüttenamt*, chief officer of the foundries, one of the *Bergamt*, (all three chosen by the Secretary of the Treasury,) and one of the examining professors. Such students as wish, after their examination, to study law in Leipsic, are, if not graduates of a gymnasium, examined in the gymnasium of Freiberg before they are allowed to do so.

The state examination at the end of the course embraces—

#### 1.—*For Miners.*

Mineralogy; geognosy, with the science of the beds or strata of ores; science of mining; elementary mechanics; mathematics; book-keeping; mining law; general art of surveying mines, (subterraneous geometry;) natural philosophy; drawing. Besides, the students have to testify to their diligent attendance of practical surveying of mines, general chemistry, metallurgy, (*hüttenkunde*,) and civil architecture, and may apply to be examined also in these four branches.

#### 2.—*For Surveyors of Mines, (markscheider.)*

General and special surveying of mines; mineralogy, limited to the principal knowledge of characteristics; geognosy and science of the beds or layers of ore, (*erzlagerstätten*;) mining law; drawing; natural philosophy; science of mining and mathematics.

#### 3.—*For Machinists.*

Science of mining; natural philosophy; civil architecture; book-keeping; general surveying of mines; drawing; higher mathematics; elementary mechanics; construction of machinery. Besides, they have to testify to their attendance on the lectures on general chemistry, metallurgy, mineralogy and geognosy.

#### 4.—*For Metallurgists, (hüttenlente.)*

Theoretical and analytical chemistry; dry and wet liquid assaying; use of the blow-pipe; metallurgy; natural philosophy; mineralogy; elementary mechanics; art of cleaning ores, (*aufbereitung*;) book-keeping; drawing; mathematics. Besides, they have to testify to their attendance of the lectures on geognosy, civil architecture, mining law, and science of mining.

At the examination they have to lay before the commission drawings of a larger size.

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#### Documents.

1. *Festschrift der Berg-Academie in Freiberg*, 1866, pp. 366, price 1½ thaler; 2. *Regulative Freiberg*, 1860; 3. *Übersicht der Vorlesungen*, 1867-68.

The oral examination lasts one day. On the second day they are examined (*a*) in drawing, especially in sketching from models, &c.; (*b*.) in making short compositions on given themes, to be done rapidly without any help, and may be connected with the drawing exercises, by which compositions the student has to show that he is able to explain himself appropriately and fully on a given subject without help and promptly. The *censuren* in the testimonial have three degrees—"excellent," "good," "satisfactory"—for all branches, out of which, with particular regard to the respective chief discipline, the principal *censur* is made up, if the student succeeded.

#### IX.—SCHOOLS FOR PRACTICAL MINERS.

(*In Freiberg.*)

There are two such schools in Saxony, in Freiberg and in Zwickau, the latter for coal-miners, both controlled by the *bergamt* in Freiberg, (with the higher boards, the *Oberbergamt* in Freiberg and the Ministry of Finances.) The former receives from the state about 800 thalers a year; the latter was founded and is supported by the proprietors of coal mines at Zwickau. These mining schools (*bergschulen*) of a lower rank have in view to train inferior officers, as workmasters, surveyors, and sub-inspectors of the (royal) mines. The number of pupils in Freiberg varies according to the wants of the government, but cannot exceed 60.

On admission, the pupils must be 17–22 years old, and have had the education of an elementary school in plain handwriting, the elements of arithmetic, including fractions, correct writing after a dictation, and some skill in drawing, and must have worked in a mine at least one year, and continue to work during their studies. Not to interrupt their work nor to lessen their wages, the lesson hours are all in the afternoon or evening, and arrangements are made with their masters that they may, on school-days, ascend, and cease working somewhat earlier, if far off from school; and may, on permission from the principal, without loss stay away a whole day in order to descend a shaft somewhere else.

The course of instruction comprises four years, in as many classes, six to seven hours a week.

*4th Class*—first year:

1. German, 2 hours a week.
2. Arithmetic, (algebra, equations with two unknown quantities,) 2 hours a week.
3. Drawing, 2 hours a week.

*3d Class*—second year:

1. Mineralogy, with an abridgment of geognosy, 3 hours a week.
2. Geometry and trigonometry, 2 hours a week.
3. Drawing, 2 hours a week.



*2d Class*—third year :

1. Natural philosophy, elements of, applied ; mathematics, and popular doctrine of machines, 2 hours a week.
2. Science of mining, 2 hours a week.
3. Drawing, 2 hours a week.

*1st Class*—fourth year :

1. Surveying of mines, 1st part, 2 hours a week.
2. " " 2d part, 2 hours a week.
3. Mineralogical exercises, 1 hour a week.
4. Book-keeping, 1 hour a week.
5. Drawing, 1 hour a week.

The school in Zwickau for coal miners is organized after the pattern in Freiberg, with four years' courses, but with one school day in the week.

For continuing elementary education the attendance at Sunday schools (evening schools) is required.

For their moral conduct, application, and attainments, the pupils receive, at the end of the fourth year, a testimonial, which will be of influence on their being employed as inferior officers of the mines.

Also some smelters, but not more than three, may be allowed to attend the mining school without being obliged to take the full course of four years or to attend all lessons. They must be recommended by the *Oberhüttenamt*, *i. e.* chief board, to superintend the furnaces, and pass the examination of admission, as required of the mining scholars.

The mining school had, in the last year, in the four classes, 60 pupils.

The school receives from the state an annual grant of 902 thalers, besides 40 thalers from the district funds.

There is also a mining school at Altenberg, which, in 1866, had 4 pupils, who were instructed in six lessons a week.

#### X.—STENOGRAPHIC INSTITUTION AT DRESDEN.

It was first established in 1834, when the stenographer, Wigard, (disciple of Gabelsberger, in Munich,) was appointed by government as stenographer for the sessions of the legislature, and obliged, at the same time, to instruct gratuitously a limited number of pupils in semi-annual courses, one hour and a half daily. In the first course, and until 1839, the number of pupils was limited to fourteen. In 1839 the Royal Stenographic Institution received its present organization, not much altered by the regulative of 1850. In 1840 the number of pupils increased to 35, in parallel classes of no more than 18 pupils; in 1842 to 57, &c. Instruction is given by different members of the institution in each course, by one chosen always by the government, (Home De-

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Document.

*Bestimmungen* (statutes) *der Freiburger Bergschule*, (drawn up in 1868.)

partment,) who generally receives for it a fee of 70 thalers, in addition to his salary, as member of the Stenographic Institution, of 500 to 800 thalers.

Instruction is given one hour daily for 8–10 months of the year. It embraces the science and rules of the stenographic system, and practical exercises in writing from dictation. In each course there are two examinations, at the end of the theoretical and of the practical instruction. The end of the course is reached when the majority of pupils are (1) perfectly familiar with the system (of Gabelsberger) and the stenographic orthography; (2,) able to read fluently their own writings; and, (3,) have acquired some skill in stenographic writing of discourses.

The beginning of a course must be duly advertised in public papers by the principal. The names of those who have applied, with the approval of the president, are to be submitted for decision to the ministry. Such as have taken the full course of a gymnasium (college) and of the university are preferred. The two examinations are held at the time appointed by the ministry, in the presence of the principal and of two other stenographers; and in case the president has been himself the teacher, of some other officer in his stead.

The number of pupils instructed last year in four courses by four teachers was 114.

Besides, there are *Fortbildungscurse*, *i. e.*, courses for continuing the study of stenography, consisting of a series of practical exercises during the six months. Last year instruction was given in four divisions to 130 pupils by the principal, Professor Heyde, who, moreover, had to instruct officially seventeen gendarmes.

In these courses four writing-matches take place, the first of which lasts fifteen, the second twenty, the third twenty-five, and the last thirty minutes. Practical stenographers are excluded. In the first match forty words are to be written in a minute, and in the last match, seventy to eighty words. Every one has to read instantly his writing, to which, as well as to the observation of the rules of the system, especially of orthography, and to the hand-writing, particular regard is paid in the distribution of prizes. The three prizes consist of books, worth five thalers, two thalers, and less; but diplomas are added, and the names published in the *Dresden Journal*. Only such competitors have to expect a prize who have partaken in the last and two previous matches, and have, also, regularly attended the other exercises. Moreover, instruction was given in the Polytechnic School to eight pupils; in the Vitzthum Gymnasium, to 14; in the Commercial School, to 18; and to several private classes. The rooms were in the State House.



Those who wish to know more about this very liberally endowed institution, with its president, Hâsse, Royal Counsellor, the principal, Heyde—in all eight stenographers of the first class, of whom several bear the title of professor, and three assistants—and about its organization, (*a*,) for the legislative, (of course omitted in this account;) (*b*,) for instruction for the same purpose; (*c*,) for the dissemination of Gabelsberger's system, in opposition to the system of Stolze, adopted in Prussia and in Dresden, maintained by a small association founded in 1852, are referred to the documents given in note.

#### XI.—THE NORMAL SCHOOL FOR TRAINING TEACHERS OF GYMNASTICS.

##### 1.—*History and General Observations.*

This institution was founded by the government (Ministry of Public Education) in 1849, at Dresden, and is supported by the same, for the purpose of obtaining a sufficient number of able teachers of gymnastics in the public schools. The first impulse toward introducing gymnastics into the public schools had been given by Prof. Werner, who established a gymnastic institution in 1830 at Dresden. This private school was closed with the departure of Werner to Dresden in 1839, but it had been so far successful for Saxony that after 1837 the government and legislature granted a certain sum for the instruction of gymnastics in several chief schools of the kingdom. Thus it was that this Normal School for obtaining teachers was established 17 years ago.

The new building, considered as a pattern establishment, was erected, 1863, at the expense of 45,415 thalers, viz: for gymnastic hall, 12,000; fitting of the hall and of the grounds, with implements, 1,519, 882 thalers, &c. Its ground-plan may be seen in the document mentioned below, with a description of the premises and of the technical arrangements, pp. 21–28.

The course of instruction, in which teachers of all kinds of schools may gratuitously partake, begins in October, and embraces one year. The pupils are as yet chiefly young teachers in the primary schools at Dresden, who, after finishing their course, are employed as teachers of gymnastics (in most cases not exclusively) at Dresden or other towns of Saxony. Occasionally, teachers in other parts of Saxony come to Dresden for the purpose of joining this institution.

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##### Documents.

1. *Correspondenzblatt des Kgl. Stenographischen Instituts*, 1864, pp. 33, in 4to, (containing the history of the Institute, and the Regulatives; 2. Catalogue of the Library, (with 1,100 stenographic works, (not volumes,) and 409 more;) 3. *Taschenbuch für Gabelsberger Stenographen*, 1868, pp. 74, (with an account of all Gabelsberger's associations in the world.)

2.—*Practical Theoretical Exercises.*

Not to disturb too much the teachers in their school-work, they have their gymnastic lessons on the afternoons of Wednesday and Saturday, when the public schools are closed; in winter in the gymnasium hall, in summer on the gymnasium grounds. The practical exercises are followed by theoretical lectures on the history, systems, and methods of gymnastics. Besides, on two evenings of the week, certain hours are given to further exercises in gymnastics. In summer, the master of a swimming establishment is employed to teach 30 teachers, pupils of this Normal School.

The said gymnastic lessons and exercises, with the principal, Dr. Kloss, are accompanied by lectures and exercises in anthropology by Prof. Günther in winter; on two evenings, anatomy and physiology; in summer, dietetics. After the anatomical course, application is made by exercising the pupils in bathing-trowsers. Moreover, the teacher-pupils may, at other times, attend the exercises of the school-classes, (see below,) when they also find opportunity to assist.

At the end of the course there is an examination, in which all who think themselves sufficiently prepared, even if they have not been pupils of the Normal School, may partake. It consists of a trial lesson, of an oral examination on theory of gymnastics and on anthropology, and of a practical examination—all this in the presence of a counsellor of the Ministry of Public Education, lasting 2–3 hours. A composition on a theme given by the Royal Commissary is to be delivered two weeks before the public examination. There was another course established in 1860 of four to five weeks, generally in September and October, to benefit teachers not residing in Dresden, who either instruct already or are preparing to instruct in gymnastics. They receive leave of absence, and often are assisted by the government in bearing the expenses of travel and board. These pupil-teachers have from 4 to 5 lessons daily, and also pass an easy examination as teachers of gymnastics in elementary schools.

From 1850 till 1864 the full year's course was taken by 168 pupils; the examination was passed by 12 more=180.

From 1860 to 1864 the short course of 4 to 5 weeks was taken by 35 pupils, and 6 more were examined as teachers of gymnastics in elementary schools=41 persons.

In the same building, and under the same direction, instruction in gymnastics is given to four classes of the 'Teachers' Seminary, 67 pupils; to seven classes of the Gymnasium, 294; to the first boys' school,



in four classes, 188; and likewise to four classes of the first girls' school, 167. Other schools have their exercises on other premises. The principal is assisted by 10 teachers, several of whom are teachers in the respective schools.

## XII.—ROYAL MILITARY SCHOOL.

### 1.—*Organization and Admission.*

The Royal Military School at Dresden was reorganized in 1867, after the war, and organized like the schools of the same rank in Prussia. Formerly it consisted of two separate schools, the artillery school and the *Cadettencorps*, both completing the education of their pupils; but now a higher academy in Prussia must be attended for finishing the professional education, either in Berlin, Erfurt, &c.

By the new "regulative," the *Cadettencorps* in Saxony consists of six classes, and has (1,) 20 free scholars; (2,) 84 half-free scholars; (3,) 20 not free scholars—in all, 124. Besides these, "volunteers" may be admitted; but, if foreigners, without any claim to being admitted afterwards to the royal army.

For admission to any of the 124 places, the sons of officers of the army, killed or invalid, or of such subalterns as have served 25 years, and of civil officers of high merits, are preferred to others.

The aspirant must have completed his 11th year of age, and not be over 18 years of age.

In general the boys must have, if 11 years old, the requisite knowledge of Quinta; if 12, of Quarta; if 13, of Quarta; if 14, of Tertia; if 15–17, of Secunda, of a gymnasium, (college.)

On admission, every pupil has to pay 100 thalers for a full equipment, for books, &c.; and to bring with him 12 shirts, 18 pairs of stockings, 18 handkerchiefs, 6 drawers, 1 pair of house shoes, 2 white cotton night-jackets.

During his stay every pupil has to pay, (besides 25 thalers for books when transferred to III,) annually, (a,) 50 thalers, if a free scholar; (b,) 110 if half free; (c,) 210 if not free; (d,) 260 if a Saxon "volunteer;" and, (e,) 300 if a foreign "volunteer."

### 2.—*Course of Instruction.*

The course of instruction in the Military School embraces six years, with six classes, of which, as was said before, VI, (the last,) V, IV, and III correspond to V, IV, and III in a gymnasium, II and I to lower

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#### Document.

*Bericht über* (report on) *die Kgl. Turnlehrer Bildungsanstalt*, von Dr. Kloss, 1864, pp. 34, (with a representation of the grounds and buildings.)

and upper Secunda, with the only difference, that instead of Greek, instruction is given in English and in the elements of a military education. It will be, therefore, sufficient to mention the course of instruction in the highest class as given in the new regulation.

1. Religion. (The number of lesson hours is not stated.)
2. Latin: Written exercises; Livy, Ovid, Virgil.
3. German: History of literature; explanation of dramatic pieces; free discourses, with a verbal résumé, and debates.
4. French: Translations; extemporalia; compositions; exercises in speaking.
5. Mathematics: Progressions; logarithms, and their application; applying of algebra to geometry; trigonometry; elements of stereometry.
6. English: Oral and written exercises; free-discourses on historical and geographical subjects; review of the same in English; reading of poetry.
7. History: Modern history; review of universal history; history of Northern Germany.
8. Geography: Mathematical and physical geography; review of political geography, with particular regard to Northern Germany.
9. Natural philosophy: Electricity, magnetism, sound and light.
10. Drawing of plans; finishing the designs of the survey.
11. Surveying: Topographical surveying on a large scale; drawing of grounds; *croquieren*.
12. Free-hand drawing. (Not obligatory.)

Those cadets to whom, in consequence of the examination at the end of the course, the testimonial of maturity for ensigncy can be given, are presented to his Majesty as "characterized" ensigns, whilst all others who do not answer the demands have to perform, in some other way, their legal service in the army.

### XIII.—THE ROYAL VETERINARY SCHOOL.

#### 1.—*Organization.*

The Royal Veterinary School was founded as a private school, 1774, and in 1780 raised to a public institution, at first only to train squadron farriers for the Saxon army; now, it has in view the education of veterinary surgeons in scientific and practical knowledge, as well as instructing smiths in the shoeing of horses. For these purposes it has, in three buildings, a hospital for all kinds of domestic animals; a workshop for shoeing; a zootomical establishment for dissecting animals; an apothecary's shop for learning pharmacy; collections of veterinary utensils and model shoes; a zootomical cabinet, with more than 3,000 preparations; a library of about 3,200 volumes, and a chemical laboratory for experimental exercises.

The course of instruction embraces three years, in three classes. The pupils of the higher classes receive, as far as possible, lodgings free in the institution. There are nine teachers: one professor of the practical

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#### Document.

*Auszug aus dem (abridgment) Regulative von Jahre, 1866, für das Kgl. Sächsische Cadetten-corps.* Dresden, 1867. Pp. 18.



veterinary science, and chief of all veterinary surgeons in Saxony; one professor of zootomy and zoophysiology; one apothecary and professor of physics and chemistry; one prosector; one assistant in the hospital; two in the experimental laboratory; one teacher of shoeing, and one for preparatory lessons.

The expenditure amounts to 11,310 thalers, of which the state pays 8,780 thalers.

The pupils pay 20 thalers annually. They must, for admission, be at least 18 years old, and healthy, and either have a testimonial of maturity from a real school, or have been at least six months in the *secunda* of a gymnasium, or pass an examination. *Hospitants*, or such as wish to attend the lectures without being admitted to the practical exercises or to the closing examination, are admitted on application without the aforesaid requirements. There were in all 39 pupils last year, (16 in the highest class;) now, 34 pupils and 10 *hospitants*; moreover, 17 civil and 10 military pupils in shoeing of horses. The course, beginning on the 1st of October, embraces three years—for such as have studied in another veterinary school, one year—before being admitted to the examination.

#### 2.—*Examination.*

This examination comprises—

1. The shoeing of horses.
2. Anatomy: Enterology, demonstration of single parts of the body, and making of an anatomical preparation.
3. Surgery: Performing (by lot) of two operations.
4. Clinics: Examining and attending one exterior and one interior disease, and making a composition thereupon or a report of dissection.
5. A composition on a given theme, taken from veterinary science, and written in the presence of a professor.
6. An oral examination, embracing all theoretical sciences taught in the school.

The objects of instruction are divided into three classes, viz:

##### A. *Preparatory sciences:*

1. General hodegetics. (How to study.)
2. Composition and elocution.
3. Mathematics: *a*, algebra; *b*, lower geometry.

##### B. *Natural sciences:*

1. Botany.
2. Zoology.
3. Geology and mineralogy.
4. Natural philosophy.
5. Chemistry, inorganic and organic.

##### C. *Special chief sciences:*

1. History of veterinary science.
2. Encyclopædia and methodology.
3. Anatomy: *a*, general, as brief introduction to physiology; *b*, special; *c*, pathological, with regard chiefly to police and judicial veterinary science.
4. Physiology, taught in its whole extent, but always as a foundation to dietetics and pathology.

5. Pharmacology : *a*, drugs; *b*, effects of medicaments; *c*, preparing of medicaments. The apothecary shop visited.
6. Dietetics and cattle breeding, with *exterieur*.
7. Shoeing of horses.
8. Pathology and therapeutics.
9. Surgery.
10. Science of operations.
11. Obstetrics.
12. Veterinary science for police and judicial affairs; exercises in writing compositions.

The examination mentioned above, which gives the right to practise, was passed by nine students, and two more who had not succeeded in a former examination and repeated the same. Two higher examinations, in order to be a veterinary surgeon of a lower or higher district, were passed successfully by four surgeons. Two persons were examined as military farriers. In shoeing, the examination before the royal committees in Dresden, Leipsie, Zwickau, and Lusatia, was passed by 195 persons, of whom 59 smith-journeymen were rejected.

The direction of the school, the examination of the students, and the inspection over all veterinary surgeons in Saxony, as well as the passing of judgments, if needed, on all veterinary affairs, are entrusted to a Royal Commission for Veterinary Affairs, consisting of a commissary of the Ministry of the Interior, (Home Department,) and of two professors of the school, (Haubner and Leisering.) In veterinary affairs extraordinary members may be added to the commission, according to the character of the question, as the general secretary of the Agricultural Associations, (the Privy Counsellor, Dr. Reuning,) the Chief Equerry of the state, an officer of the cavalry, and the chief farrier of the army.

As Saxony is divided into many districts, with a physician in each, who is appointed by government, (generally with a small salary,) and has to serve in all cases belonging to judicial or administrative cognizance, &c., so there are several veterinary districts of a larger compass.

### 3.—Statistics.

The annual report of the commission of 1866–67 shows that in that year 540 horses, 6 ruminant animals, 13 pigs, 308 dogs, 7 cats, and 9 fowls—in all 883 animals—have been treated in the clinics of the school, 442 of which were dismissed cured and 162 in a better state. In the itinerant clinics, 1,408 animals were attended. The external clinics comprised 234 animals. One hundred and seventy-five animals were dissected.

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### Documents.

1. *Bestimmungen den besuch der Thierarzneischule betreffend*; 2. *Unterrichtsplan*, (Plan of Studies,) pp. 12, with some notes by Prof. Leisering; 3. Laws for the Pupils of the Veterinary School, pp. 24; 4. Annual Report on Veterinary Affairs in Saxony for the year 1866, (11th year,) by the Royal Commission, by Charles Haubner, pp. 78.



## XIV.—SUPPLEMENTARY SCHOOLS.

Evening and supplementary schools, for by this name we may call all those schools which are intended for practical workmen, apprentices and journeymen, who may, without being interrupted in their daily work, supply any deficiencies in their general education, and acquire some knowledge and skill appropriate to their respective trades.

## SUNDAY SCHOOLS

In this class must first be mentioned the great mass of Sunday schools, as they are called here, because instruction is generally given on Sunday afternoon by one or more teachers of the public schools. Those which aim at continuing general education are under the care of the Ministry of Public Education, (A;) whilst those of a more industrial character are supported so far as it may be necessary and superintended by the Ministry of the Interior, (B.)

1. The Sunday schools (A) founded and supported by associations or municipalities received, in 1865, a State grant amounting to 3,035 thalers=11,381 francs. There were 93 such schools, attended in the said year by 7,021 pupils, with 299 teachers. By the latest account, in the annual report of the Chamber of Commerce and Industry in the district of Dresden for 1867,\* the Sunday schools in the seventeen towns of the district (Dresden, Freiberg, Meissen, &c.) had 1,415 pupils, (733 apprentices,) with 56 teachers, in 46 classes, and 115 weekly lessons. In these seventeen towns instruction was given in—

	<i>Lessons.</i>	<i>Towns.</i>
Drawing.....	40	All.
Modeling .....	2	1
Arithmetic.....	28	All.
Geometry.....	6	6
Natural science.....	6	6
Natural history.....	1	1
Book-keeping .....	1	1
History and geography.....	6	6
German composition.....	15	12
Calligraphy.....	16	14

They received from the State 525 thalers, (in 12 towns;) from the municipalities, 307, (in 11 towns;) from the guilds, 102, (7 towns;) from the industrial associations, 69, (7 towns;) from a school association in Dresden, 147; in Freiberg, 98 thalers; voluntary grants, 76, (in 3 towns;) in all, 1,723 thalers, and expended 1,244 thalers. The pupil, in nearly all the towns, pays a trifling entrance fee. To be more

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\* There are four such Chambers, in Dresden, Leipsic, Chemnitz, Plauen, besides Lusatia, and as many annual reports. The report of Dresden, mentioned above, contains, on 209 pp., 1, Opinions; 2, Statements of facts concerning all kinds of commerce and manufactures, mentioning most accurately the amount of the different raw productions and manufactured goods in the district, as well as the railroad and postal commerce, &c.; Schools, p. 188—195.

particular, the Sunday school in Dresden, founded 1816 by a Free Masons' lodge, is supported by an association consisting of 168 members, including 14 guilds and 2 Masonic lodges. It had last year an income of 729 and an expenditure of 404 thalers, 377 of which were paid to teachers. The school was attended during the year by 256 pupils. The entrance fee amounts to one thaler, (in one town  $\frac{1}{2}$  thaler, in one town  $\frac{1}{3}$ , in some  $\frac{1}{6}$  thaler, in others no pay at all.)

2. The Sunday schools (B) of a more special character are established in the manufacturing towns or villages. There were, some years ago, 20 such schools, with 6,326 pupils and 140 teachers. The annual expenditure was then 8,554 thalers, to which the state (Ministry of the Interior) granted 3,295. Of these schools, the most important is the Sunday school in Chemnitz, founded in 1830, and kept by the Trades' Union, with 1,376 pupils in 1868, who were instructed by 40 teachers, in 48 classes, at an expense of 2,200 thalers, to which the state grants 1,000 thalers and the town of Chemnitz 200 thalers. Lessons are given on Sunday A. M., 10 to 12, (20 classes,) and P. M., 1 to 3, (24 classes. Four classes (book-keeping, history and geography, and French) are held in the evenings of week-days from 7 to 9 o'clock. The different objects are—

1. Drawing, in 21 classes, viz :
  - a. Mechanical, in 7 classes.
  - b. Free-hand, in 7 classes.
  - c. From plaster models, 1 class.
  - d. From nature, 1 class.
  - e. Architectural, 3 classes.
  - f. Ornamental, 2 classes.
2. Arithmetic, in 7 classes.
3. Geometry, in 1 class.
4. Chemistry and natural philosophy, in 1 class.
5. Stenography, in 1 class.
6. Book-keeping, in 1 class.
7. History and geography, in 1 class.
8. German language and calligraphy, in 10 classes.
9. German composition, in 3 classes.
10. French, in 2 classes.

There was added to it in 1865 a supplementary school for young ladies, as has been already mentioned. They are instructed in German correspondence, (2 lessons,) commercial arithmetic, (2,) and in book-keeping, (2,) on Tuesdays, Thursdays, and Fridays, from 4 to 6. The course embraces one year, and is attended on the average by 30 female pupils.

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Documents.

1. Annual report of the Chamber of Commerce in the district of Dresden, 1867, pp. 209 ; 2. Report on the Sunday school in Dresden, on its half-centennial anniversary, pp. 16 ; 3. Letter of the principal of the Sunday school in Chemnitz ; 4. Exposé on public education in Saxony, pp. 11.



## EVENING SCHOOLS

To this class of schools belong—

3. The Commercial Schools for apprentices, spoken of above.

4. The Ornamental Drawing School, which is joined to the Home Industrial School in Chemnitz, and has been spoken of in connection with the same.

The Drawing Schools in Seiffen, &c.

5. The Industrial School in Dresden. This school was founded in 1861 by the Trades Union, and embraces four sections, viz: Two for apprentices and journeymen, (111 pupils;) one for established tradesmen, (18;) one for female pupils, (12.) The charge for the full course is 12 thalers a year; for single branches, 4–8 thalers; balance is remitted to poor pupils. The school received 200 thalers from the state, 200 from the town, and 215 from the Trades Union. The pupils are instructed by seven teachers in seven classes,  $7\frac{1}{2}$ – $9\frac{1}{2}$  in the evening and on Sundays. Instruction is given in drawing, four lessons; arithmetic, four lessons; modeling, four lessons; German, four lessons; calligraphy, one lesson; book-keeping, two lessons; geometry, two lessons; natural philosophy and chemistry, two lessons. There are more such schools in Saxony.

6. The Workingmen's Association for Education in Dresden has 350 pupil-members, one-third of whom are less than 18 years old. Instruction is given by six teachers: in arithmetic, two lessons; drawing, three lessons; German, one lesson; French, two lessons; English, two lessons; singing, two lessons; and gymnastics, four lessons. The association receives from the town 100 thalers, and has to raise annually 600 thalers.

7. The Mining Schools in Freiberg and Zwickau also belong to this class of schools. They are spoken of after the Academy for Miners in Freiberg. Another mining school exists in Altenberg, with 4 pupils, who are instructed in six lessons a week.

8. Four Nautical Schools have been established to give the necessary instruction for the pilot's examination. The schools are kept in the winter, when shipping on the Elbe is interrupted. They have 40–70 pupils, who pay one thaler for each course, and thus receive an annual state grant of 350 thalers.

9. Two Music Schools are established and supported by government in two small towns where the chief trade is the manufacturing of musical instruments, and carried on on a large scale, even with America. They have about 80 pupils.

10. Seven Weaving Schools give nearly the same instruction as the

two higher weaving schools in Chemnitz (spoken of above) and Glauchau, but on a reduced scale. They have about 550 pupils, and receive from the state 290 thalers a year.

11. Two Fringe-making Schools, in Annaberg and a neighboring town, have each 150 pupils, and receive a state grant of 350 thalers.

12. The Tailors' Academy, in Dresden, founded by an association of tailors from all parts of Germany, was inaugurated last year in a magnificent building, and commenced its courses the 2d of January, 1868. Besides the scientific course of one year, with 5-7 lessons daily and 3-5 hours exercises, for which the pupil pays 100 thalers, (boarding 180-240 thalers,) the prospectus mentions five practical lessons from six weeks to six months. In 1866 the school had five teachers and 38 pupils. The institution, with which the school is and has been connected, bears, since 1862, the name of "European Academy of Modes." The magazine is edited by the academy in German, French, and English, with ten different titles: Australian Observer, Season of Fashion for Gentlemen, Telegraph, (for the United States and Canada,) *l'Observateur*, &c. The association consists at present of 14 directors, residing in Berlin, London, New York, Paris, Petersburg, Vienna, and 408 members. The chief directory consists of three members, chosen for life, (Müller, in Dresden, the head and soul of all,) and has its permanent seat in Dresden. The library contains 900 volumes for this special branch, and the collections contain all sorts of models, gearing-machines, measuring apparatus, and other inventions.

Industrial schools for children who attend the elementary schools.

Spinning schools in some parts of Lusatia, three of which receive an annual state grant of 150 thalers.

Straw-working schools, three of which receive a grant of 100 thalers.

Lace-making and embroidering schools have been likewise established for children who attend this elementary school, chiefly in the poorest parts of the Ore Mountains. There are about 30 such schools, with 1,600 to 1,900 children, with an annual state grant of 4,000 thalers. For all of them an inspector is appointed, who has also the care of training the needed (female) teachers.

#### SCHOOL FOR DEAF MUTES AND THE BLIND IN DRESDEN AND LEIPSIC.

The school in Leipsic was established by Heinicke in 1778, who transferred it there from Eppendorf, near Hamburg; it was one of the first, if not the first in Germany. There are 50 boys and 50 girls, instructed by 12 male and 2 female teachers. The expenditure is 13,000 thalers. The school in Dresden has 63 boys and 45 girls, with



12 male and 2 female teachers, and now all deaf and dumb persons in Saxony enjoy the advantages of education.

Besides, there is in Dresden an asylum for deaf and dumb girls, supported by an association, where a limited number of girls find a refuge for life.

#### THE SCHOOL FOR THE BLIND IN DRESDEN.

This school was founded in 1809, and has about 111 pupils. The expenditure is about 15,448, with an income of 16,042 thalers. The funds of the school amount to 42,615 thalers; those for the blind who have left the school, to 43,000 thalers, and other funds to 46,800 thalers. Families have to pay 64 thalers a year; communities, 32 thalers for each pupil.

The preparatory school in Hubertsburg was opened in 1862. It has 17 children until their 11th year of age, (the pay is 64 thalers,) besides 3 ordinary male teachers and 3 female teachers. There are in Dresden 2 teachers of music and singing, 1 of basket making, 1 of rope making, and 1 of shoemaking; in Hubertsburg, besides the principal, 1 of bonnet making and 1 of knitting.

#### ACADEMIES OF FINE ARTS.

##### I.—THE ACADEMY OF FINE ARTS IN DRESDEN.

##### 1.—*General Observations.*

The Academy of Fine Arts, (*Academie der bildenden Künste*,) established in 1705 as an academy of painting, was, in 1764, changed to the Academy of Arts, and received in 1836 its present organization. Its administration is entrusted to an academical council, the honorary president of which is H. R. H. Prince George. The council consists of a Royal Commissary, at present the Secretary of the Treasury, a counsellor of the government as secretary, and nine professors. The same council is the directory of the Academy of Arts in Leipsic.

There being no special principal of the academy in Dresden, the superintendence of studies and discipline is entrusted temporarily to one of the professors, who is at present, 1868, Gustavus Heine, professor of architecture.

The academy consists of two sections, viz, the Academy of Arts, (*Kunstakademie*,) and the Architectural School, (*bauschule*.) There are in all twenty-one professors, two of whom are employed mostly in the Polytechnic and in the Veterinary School.

The number of students in 1866 was, in the first section, 95, with 41 not Saxons; in the Architectural Academy, 41, with 10 foreigners;

in all, 136 students, with 51 foreigners. The academy is situated on the *Brühlsche Terrasse*, and at the same place, during three summer months, holds its well-known annual exhibition. The income from the exhibition is half applied to purchasing good paintings, exhibited by Saxon artists, to be placed in the picture gallery; half of it to the fund for supporting orphans and widows of artists. This fund was founded without any particular capital in 1836, and has increased to the present amount of 25,900 thalers, and in the last few years has expended for relief annually 800 thalers; besides, it is worth mentioning, that, for promoting art in Saxony, the state granted, in 1858, 5,000, afterwards 10,000 thalers annually for constructing excellent monumental works, which grant will probably be continued henceforth by the government and legislature.

The budget of the home department shows an annual expenditure for the academy of 18,030 thalers. The students pay an entrance fee of 5 thalers, and annually 6 thalers in the lowest class; 10 thalers in all other classes.

Students who have exhibited artistical or architectural works, or models of some merit, are rewarded at the end of the exhibition by medals or diplomas. One of them receives a (*reisestipendium*) stipend for travelling (to Florence and Rome, and on application to the council, to other cities) of 1,200 thalers; 600 for each of the two years for which it is granted. The great gold medal is considered of equal worth as the stipend.

The summer term in the proper Academy of Arts begins April 15; the winter term, November 1; in the Architectural Academy, October 1, and in some cases a student may be admitted here on the first of March.

#### II.—THE ACADEMY OF ARTS—*Kunstacademie*.—SECTION I.

The full course of the academy has three annual courses, (classes,) called, III, the Drawing Hall, (*zeichnensaal*;) II, the Plaster Hall, (*gypssaal*;) and, I, (the highest class,) the Painting Hall, (*malersaal*.) Besides those classes, there exist for the higher training of the advanced students seven "ateliers;" two for historical painting, I, (Profs. Hubner and Schnorr;) one for landscape painting, (Ludwig Richter;) one for statuary, (Hähnet;) one for engraving, (Gruner;) one for wood cutting, (Bürkner;) and one for architecture, (Nicolai.) The collections of art in Dresden, of so great importance to the future artists, are too well known to be pointed out here. The plan of studies is as follows:

*Lower Class—Drawing Hall—under the Direction of Three Professors.*

Drawing of single parts of the human body and of whole figures from copies;



first instruction in drawing from plaster models; 9-12 and 2-4 daily, except Saturday afternoon.

*Middle Class—Plaster Hall—under the Direction of Three Professors.*

Drawing from statues and from single parts of them in plaster casts, and every fourth week first instruction in drawing from the living model; 8-12 and 2-4, and in some months 5-7 daily, except Saturday afternoon.

*Upper Class—Painting Hall.*

Drawing and painting from pictures and from nature, 8-12 and 2-4 daily, except Saturday, only in winter, (October 1 till May)—one professor; drawing and modeling from the living model and from garments, May till the end of September, 8-10 and 2-4 daily; in winter, daily, 5-7, (to the end of February)—4 professors. The students of this class may attend the course in the lower classes, so far as the room allows.

*Ateliers.*

The admission of students in the ateliers is left to the judgment of the above-mentioned directory of the respective ateliers and to the academical council. The student of an atelier has to attend any instruction which the director of his atelier may think appropriate.

*Scientific Instruction.*

*a.* For all students of the two higher classes and of the ateliers, except the students of the Architectural School:

1. Lectures on muscles and bones, in winter.
2. Anatomy of domestic animals, especially of horses, in the Veterinary School.

*b.* For all classes, except the architects:

1. Lectures on history of art, in winter.
2. General history, in winter.
3. Linear perspective, and the perspective of shade and light, in summer and winter, on two days, 8-10 A. M. Vacations, besides the holiday weeks, the whole month of August.

III.—THE ARCHITECTURAL ACADEMY, OR SECTION B.

(*Bauschule.*)

Instruction from October 1 until February 28, and from March 1 to August 31.

The plan of studies is as follows:

1. Exercises in projection; construction of shades; geometrical representation of single parts of a building, of the orders of columns, of ground plans, as well as of whole delineations, from approved models; independent construction of plans after given programmes; composing of ornaments, "and similar exercises."
2. Drawing, with pencil and Indian ink, of ornaments from papers and plaster-models; exercises in applying perspective, with painting in water colors, &c.
3. Doctrine of iron construction, in application to the different kinds of architecture.

These exercises take place daily, 8-12 and 2-5, (in summer 2-4,) under the direction of three professors.

Besides, there are lectures—

1. On the estimating of the costs of a building (*bauauschläge*) two hours a week in winter.
  2. Mathematics, four hours in winter.
  3. History of architecture, two hours
  4. Lectures on perspective, two hours
- } summer and winter.

The more advanced students, generally after the third year, work in the above-mentioned ateliers of Prof. Nicolai, and prepare themselves there for the practical application of architectural science. For admission, all students of architecture must testify that they have successfully attended either the general course of the Polytechnic School or made the full course of an Industrial or of a lower Architectural School, (*baugewerkschule*, for masons and carpenters, see above,) or at least have attained the same knowledge which is acquired in the above-named classes or schools.

For finishing the education in mathematics and in construction of roads, bridges, and hydraulic works, the Polytechnic School may be attended in the higher classes of its professional department. This is, however, necessary for all who wish to pass the state examination, which has been mentioned, after three years of practical work. The instruction in architecture at the Academy of Arts aims at a higher artistic education, while all students who want a scientific foundation for their practical and technical studies are recommended to the Polytechnic School.

To show the equal standing of the two sections of the Academy of Fine Arts, and, so far as it is possible, the requisites for a prize work of art, (the competitors being from the academy in Dresden and from that in Leipsic, the latter, however, having no architectural academy,) we add that the artistic branches, which are considered in granting the highest prize, (stipend for travelling of 1,200 thalers for two years, at 600 thalers for each, or the great gold medal,) are set down in the "Programme on Academical Prizes, 1864," in the following order:

- A. Architecture. (See below.)
- B. Statuary. (A statue at least 4 feet high, or a *haut-relief* of two or more figures at least  $2\frac{1}{2}$  feet high, which may be executed in plaster.)
- C. Painting. (A perfect oil painting of history, *genre*, or landscape, including the sea, with at least half-length figures.)
- D. Engraving in copper.
  - a. A copper plate from a historical painting, linear-shaped, at least 120 square inches large, from such paintings as have not yet been sufficiently engraved.
  - b. Do., a landscape etched and executed by the chisel, of such worth that it may be considered equal to a historical painting, and the figures, if there be any on the engraving, at least 2 inches high.

In architecture, the plan of a building is required which is destined to serve a higher purpose than common houses. The director of the architectural *atelier* may propose a certain programme for all competitors.

The plan must embrace—

- a. The requisite outlines, and, if needed, the topographical plan.
- b. The sketches (elevations, *aufschnitte*) of the principal façades.
- c. The transepts (*durchschnitte*) necessary for illustration.
- d. Details on an accommodating scale.



## SPECIAL SCHOOLS IN SAXONY.

e. A written exposition of the objects on which the organism of the work is based, in two copies, one for the Academical Council and one to be laid by the side of the exhibited object.

### II.—THE ACADEMY OF ARTS IN LEIPSIC.

#### 1.—*Organization.*

The Academy of Arts at Leipsic was founded in the same year, 1764, with the academy in Dresden, and is placed under the Academical Council in Dresden.

According to the written statements of the principal, Professor Tager, it contains—

1. A copying room, (*copirsaal*,) in which the students draw from originals and make the needed preparatory studies in anatomy.

2. A plaster room, (*gypssaal*,) where students draw from casts of antique statues.

3. Living-model room (*actsaal*) and *atelier*. In this highest class the students draw from portraits and living models; also they make their own compositions in cartoons and oil paintings. The more advanced students of the second class are allowed to join in these studies in winter, from 5 to 7 P. M.

#### 2.—*Tuition and Studies.*

The annual tuition fee in the two lower classes is 6 thalers; in the highest class 10 thalers; but poor students may, after the first year, if provided with good testimonials from their teachers, attend gratis.

The principal directs the studies of the highest class, and in the *atelier*. For the two lower classes there were formerly two teachers; at present they have but one.

It appears therefrom that it has no architectural section or academy like that in Dresden; but, instead of it, there is an Architectural School for masons and carpenters (*baugewerkenschule*) joined to it, (principal architect, Zocker,) as there is one connected with the Polytechnic School, at least under the same principal, and one with the Industrial School at Chemnitz, though they have separate organizations. In regard to these architectural schools see above.

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#### Documents.

1. Plans of studies in the two sections of the Academy of Fine Arts in Dresden; 2. Prescriptions for students concerning studies and discipline in Dresden; 3. On academical prizes; 4. Two testimonials as they are given to students after each six monthly term and to graduates; 5. A short account of the academy in Leipsic, written by Prof. Jager.

No. 1 contains many valuable notes, written by Prof. Heine, in Dresden.

There has been published at the centennial anniversary a *festschrift*, written by Dr. Weisser, the secretary of the academy, which contains its history.

## THE CONSERVATORIO OF MUSIC IN LEIPSIK

1.—*General Observations.*

This academy of music at Leipsic, sanctioned and supported by the favor of H. M. the King, was established at Easter, 1843, with the energetic and intelligent co-operation of the celebrated Mendelssohn Bartholdy. The object is the higher education in music. The instruction it imparts embraces, theoretically and practically, all branches of music considered as an art and science. The supreme direction of the academy is in the hands of five trustees, who form the "directory;" at present one is the Minister of Public Education, (not as such;) another a member of the municipality, &c.

For admission, the pupils pass an examination to show their qualifications for understanding the lectures, and for a successful study of music. The number of pupils is at present 146, 91 males and 55 females, with 14 teachers and one inspector.

The fee for the whole instruction (excepting the orchestral instruments, double bass and wind instruments, for which a moderate extra fee is paid) is 80 thalers a year, paid quarterly in advance, besides an entrance fee of 3 thalers and one thaler to the *castellan* of the school. There are six free scholarships founded by the king, to be held by poor and talented Saxons for one year, which may be prolonged to two or three years. All pupils have to procure the instruments, (one piano, which may be hired by foreigners,) music and books at their own expense

2.—*Studies.*

The theoretical instruction, given chiefly by M. Hauptmann, 1868, consists of a complete course on the theory of music and composition, which is completed in three years. More advanced pupils, who are at once placed in the upper classes, may complete the study in a shorter time, but they are required to attend at the same time the lessons in the lower classes as reviews. It comprises the following subjects :

*a.* Harmony, in 15 classes : During the first year, harmony, and part writing ; in the second, continuation of harmony and counterpoint ; in the third, continuation of harmony, double counterpoint and fugue.

*b.* Form and composition, in 6 classes : Oral instruction and exercises, including vocal and instrumental composition in their various forms and treatment, analysis of classical musical works.

*c.* Playing from score : Conducting, with practical exercises.

*d.* Italian language for those who purpose to devote themselves to the higher branches of solo singing.

Moreover, lectures on musical subjects, such as the history of ancient and modern music, æsthetics of music, &c.



## SPECIAL INSTRUCTION IN SAXE-ALTENBURG.

### INTRODUCTION.

THE Duchy of Saxe-Altenburg, on an area of 509 English square miles, in 1864 had a population of 141,839, who are almost exclusively engaged in agriculture.

The total annual expenditure of the government of Saxe-Altenburg during the financial period 1862-64, amounted to 800,343 thalers.

The institutions of public instruction are administered by the minister of education and ecclesiastical affairs, who is at the same time minister of the ducal house.

1. *Primary Schools.* Of these there were 179 schools, with 21,798 scholars, and about 190 teachers; 1 infants' asylum, with 80 children.

2. *Secondary Schools.* There is one gymnasium, with 189 scholars, and 12 teachers; 1 progymnasium, with 183 scholars, and 7 teachers; 1 higher burgher school, with 191 scholars, and 11 teachers, besides 7 burgher schools, with two classes; the Carolinum, with 4 classes, and 80 pupils; besides several schools of girls, of the highest grade and reputation.

3. *Superior School.* University students resort to Jena.

4. *Special and professional Schools.*

1 Teachers' seminary, at Altenburg, with 32 students.

7 Industrial (*fortbildung*) schools, with about 350 pupils.

1 Commercial school, at Altenburg.

1 Agricultural colony, or asylum, (*George & Mary House*), for neglected children.

1 Agricultural winter school.

1 Institution for the widows and orphans of teachers.

1 Institution for the deaf and dumb.

Belonging to the primary schools, there is the Amelia Institute at Altenburg, with 80 pupils; another at Kahla, with 40 pupils; 3 kindergarten, at Kahla, Ronneburg, and Altenburg, with a total of 95 children. There are several private schools for young children, of great excellence.

## SPECIAL INSTRUCTION IN SAXE-COBURG-GOTHA.

### INTRODUCTION.

THE Duchy of Saxe-Coburg-Gotha, on an area of 816 English square miles, had in 1864, a population of 164,527, chiefly engaged in agriculture.

The total annual expenditure in the financial period 1861-65, amounted to 992,169 thalers, of which sum about 30,000 thalers were expended for primary instruction, and 8,000 for secondary instruction. The annual expense for the salaries of common school teachers in 1866, was 72,000 thalers.

The institutions of public instruction are administered by the minister of state, and embrace :

1. *Primary Schools.* Of these there were in 1864, 223 schools, with 355 teachers, and 22,609 scholars.

2. *Secondary Schools.* There are 2 gymnasia, with 35 teachers, and 606 scholars; 2 real schools, with 23 teachers, and 449 scholars; 3 higher burgher schools, with 27 teachers, and 1,254 scholars; 2 higher girls' schools, with 23 teachers, and 256 scholars.

3. *Superior Schools.* University students resort to Jena.

4. *Special and Professional Schools.*

3 Teachers' seminaries, with about 90 students, and about 25 teachers.

1 School for architects and carpenters; 1 supplementary school for mechanics; 1 school for machine-building,—with about 150 scholars, and upwards of 20 teachers. Besides this great institute, there are several schools for mechanics receiving aid from the state.

1 Deaf mute institute, with 14 inmates.

1 Commercial school, with 5 teachers, and 110 pupils.

1 Agricultural school.

1 Music school.

1 Orphan asylum, at Friedrichroda, founded in 1712.

3 Kindergarten, with 150 children.

1 Rescue institution.

Salzman's Institute at Schnepfenthal, Dietendorfer Institute, Maria Institute at Gotha, have a high reputation.



## SPECIAL INSTRUCTION IN SAXE-MEININGEN-HILDBURGHAUSEN.

### INTRODUCTION.

THE duchy of Saxe-Meiningen-Hildburghausen, on an area of 933 English square miles, in 1864 had a population of 178,005, of whom the majority are engaged in agriculture, 549 in mining, 1,472 in porcelain manufactories, and about 8,000 in the manufacture of wooden toys.

The total annual expenditure of the government of Saxe-Meiningen in the financial period 1862-65, amounted to 1,845,042 florins, of which 16,000 florins were expended for primary schools, besides the income (14,000 florins) from the crown lands. The main expense falls on the local districts.

The institutions of public instruction are administered by the minister of education and ecclesiastical affairs, (who at the same time is minister of justice, who is assisted in the inspection of schools by a council consisting of two clergymen, and one layman, who must have been a teacher), and include:

1. *Primary Schools.* Of these there were in 1864, 285, with 29,250 scholars, and 406 teachers:—that is, about 1 school to every 620 inhabitants; 102 scholars to every school, and 2 teachers to every school.

2. *Secondary Schools.* 2 gymnasia, with 310 scholars, and 22 teachers; 2 real schools, with 290 scholars, and 19 teachers; 1 higher girls' school, with 50 scholars, and 7 teachers.

3. *Superior Schools.* University pupils resort to Jena.

4. *Special and Professional Schools.*

1 Agricultural school, and 4 model farms.

1 Teachers' seminary, with 9 teachers, and 52 students.

1 Industrial school, with about 20 pupils.

1 Deaf mute institute, with from 15 to 20 inmates.

1 Reform school, with about 24 pupils.

3 Public asylums for orphans.

1 Asylum for the orphans of teachers.

1 Home for neglected children.

10 Kindergarten, after Froebel's method.

## SPECIAL INSTRUCTION IN SAXE-WEIMAR.

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### INTRODUCTION.

THE Grand-duchy of Saxe-Weimar-Eisenach, on an area of 1,421 English square miles, in 1864 had a population of 280,201, of which number 92,702 were engaged in agriculture, 137,603 in industrial pursuits, and 9,855 were engaged in commerce.

The total annual expenditure of the government of Saxe-Weimar in 1864-65, amounted to 1,658,668 thalers, of which 40,000 thalers were expended for primary schools, 25,835 for secondary schools, and 5,090 for special schools.

The institutions of public instruction are administered by the minister of the interior, who at the same time is minister of the grand-ducal house, and minister of foreign affairs.

1. *Primary Schools.* Of these there were 678, with about 50,000 scholars, and about 700 teachers; besides 77 repetition schools.

2. *Secondary Schools.* There are 2 gymnasia, with 572 scholars, and 39 teachers; 2 real schools, with 337 scholars, and 18 teachers; 4 higher burgher schools, with 1,517 scholars, and 35 teachers; 1 higher girls' school, with 135 scholars, and 25 teachers. Besides these, there are 2 private boys' schools, with about 200 scholars, and 38 teachers, as also 2 private girls' schools.

3. *Superior Schools.* The University at Jena, common for all the Thuringen States, with four faculties (theology, law, medicine, philosophy), had 440 students, and 67 professors.

4. *Special and Professional Schools.*

2 Teachers' seminaries, with 302 students.

2 Schools of architecture and carpentry.

1 School of forestry, and 1 School of agriculture.

1 Commercial academy.

1 School of pharmacy.

1 Institute (*Falk's*) for neglected children.

10 Kindergarten.

1 Institute for deaf mutes; 1 Institute for the blind, at Weimar.

77 *Fortbildung*, or supplementary schools.

Orphans, 1,200, are placed in families, and attend the public schools with other children.



## SPECIAL INSTRUCTION IN WURTEMBERG.

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### INTRODUCTION.

THE kingdom of Wurtemberg, on an area of 7,840 English square miles, in 1867, had 1,778,478 inhabitants, of which number 276,000 were employed in agriculture, 225,000 in mechanical pursuits, and 48,000 as day-laborers, &c.

The total annual expenditure of the government of Wurtemberg during the financial period 1864-65 was 17,064,236 florins, of which 226,270 fl. were expended for elementary public instruction. The institutions of public instruction are administered by the Minister of Education and of Ecclesiastical Affairs.

1. *Primary Schools.*—Of these there were, in 1865, 2,168, with 2,721 teachers and 230,712 pupils. Besides these there were 691 evening-schools, intended for further instruction in those branches of study which find a special application in practical life; and 142 infant schools, with 8,953 children.

2. *Secondary Schools.*—There were, in 1868, 4 gymnasiums, with 635 scholars and 76 teachers; 3 gymnasia with real-school classes, with 1,438 scholars and 92 teachers; 5 lyceums, with 574 scholars and 38 teachers; 9 real-schools, with 2,006 scholars and 100 teachers—making a total of 21 secondary schools, with 4,653 scholars and 306 teachers.

3. *Superior Schools.*—The university at Tubingen, in four faculties, [theology, law, medicine, philosophy,] had 78 professors and 785 students. Besides the theological faculty of Tubingen, numbering 331 students, there are 4 Protestant theological seminaries, with upwards of 100 students and 26 teachers.

4. *Special and Professional Schools.*—3 Teachers' seminaries, with 230 students and 23 teachers; 1 technical university, with 49 teachers and 468 students; 1 college for the building trades, with 26 teachers and 578 students; 108 higher trade-schools, with 425 teachers and 8,264 pupils; 1 academy of agriculture and forestry, with 123 students and 21 teachers; 3 farm-schools, with 12 pupils; 523 finishing farming schools, classes, &c., attended by 12,040 persons; 1 veterinary college, with 6 professors and 57 pupils; 1 school of art, with 8 teachers and 55 pupils; 1,450 industrial schools, with 52,157 pupils.

5. *Supplementary Schools and Agencies.*—Wurtemberg has a large number of Sunday-schools, infant-schools, orphan asylums, rescue institutions, working-men's unions for debates, lectures, reading rooms, evening schools, recreations, savings bank, life and accident insurance, &c. of its members and their apprentices, and other appliances for reaching the juvenile population, so that it is the boast of her educators that this government has more nearly solved the problem of universal education than any State of Europe.

## SYSTEM AND INSTITUTIONS OF TECHNICAL INSTRUCTION.

Wurtemberg, without possessing a system of technical instruction under a special ministry, has most of the agencies and institutions which are considered desirable or necessary for this purpose in the present industrial condition of the population.

I. There is a system of public schools, so distributed and administered as not only to solve more nearly the problem of universal education than that of any other State, but to make special technical instruction practicable and economical.

The laws forbid the employment of very young persons in factory or other labor, unless they have been at school, or can obtain further instruction while so employed; and for this purpose, in every manufacturing or mechanical population, there is a special school for this class of children.

II. As an indispensable instrument in technical instruction, provision is made for all persons over twelve years of age to acquire skill in drawing, by imparting to all teachers the ability to give instruction in this branch, and introduce it into every school of general and special education.

III. Trade-schools to the number of 108 (varying in their studies according to the demand) are so distributed through all the centers of population as to meet practically the wants of every trade.

IV. A College for building trades, with 26 teachers.

V. A Technical University at Stuttgart, with 49 teachers, giving instruction, (1) in architecture; (2) engineering; (3) machinery; (4) chemistry in its applications to manufactures, mines, metallurgy, and pharmacy.

VI. Colleges and Courses for Agriculture, Forestry, and Rural Economy generally, including the great institution at Hohenheim, three schools of practical farming, a school for gardening, a chair in the university, and 360 evening schools, besides practical lectures and conferences, scattered through the country.

VII. A Veterinary College at Stuttgart.

VIII. A School of Art, embracing every facility of drawing, modeling, landscape, water and oil painting, and statuary.

IX. Special Instruction in Commerce in the Real Schools.

X. Central Museum of Industrial Art.

In connection with the Industrial Museum there is a collection of models in aid of instruction in drawing, design, and modeling, and a workshop for reproducing them in plaster, from which any article on the catalogue can be ordered at the cost price to the molder.



## AGRICULTURAL INSTRUCTION.

There are in Wurtemberg the following different sources of agricultural instruction:—

1. The royal agricultural and forestry institute at Hohenheim.
2. Three school farms at Ellwangen, Ochsenhausen, Kirchberg.
3. An agricultural chair at Tübingen.
4. A veterinary school at Stuttgart.
5. Apprenticeships on the large private farms.
6. Agricultural improvement schools, which vary in their aims and methods in different localities, viz.: in the winter of 1866-67, one hundred and seventy voluntary schools, with three thousand two hundred and sixty-six pupils; three hundred and sixty obligatory evening schools in which agricultural instruction was given, with seven thousand nine hundred and thirteen pupils, the so-called agricultural evening meetings in sixty communities, with fourteen hundred and sixty-one visitors, and seventy-eight reading circles, with two thousand and thirty-four members.
7. Lectures by practical farmers and agriculturists, employed by the department to visit different sections, discuss special subjects, and cooperate with the local agricultural association in special improvement.
8. Free distribution of agricultural reports and philosophical experiments among agricultural schools, associations, clubs, reading-rooms and libraries.
9. Special instruction to home pupils in the institute.

The institute at Hohenheim is by far the most important of these, and was the starting point of public interference in this branch of instruction. The person to whom it, and therefore the cause of agricultural education not only in Wurtemberg but in the world, owes its origin, was Schwerz, who was born at Coblenz, June 11, 1759. He founded the institute in 1818, and died Sept. 3, 1828. He brought with him to the school, a system of agriculture based on the practice of the Flemish cultivators, a system which has since been gradually superseded by one involving larger and more scientific operations.

The school farms of Ellwangen and Ochsenhausen date as recently as 1842, the funds having been subscribed for the purpose of erecting a monument to the king, and being at his request applied to this purpose.

The apprentices on the large private farms are, in general, preparing themselves to enter the Hohenheim school.

The instruction given at the Tübingen university is not only highly scientific but very practical in its character, but for a class of students, however, with whom agriculture is to be rather a taste than a serious employment.

## \* INSTITUTE OF AGRICULTURE AND FORESTRY.\*

Hohenheim is seven miles from Stuttgart, the capital of the kingdom of Wurtemberg, the road lying through vineyards and orchards and royal forests. Long before my arrival at head-quarters, it was easy to see that I was riding through the fields of the institute. The fruit trees were labeled and numbered,

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\*Abridged from Report of Secretary C. L. Flint to the Massachusetts Board of Agriculture, on the Agricultural Schools of Europe, 1863.

the fields and the rotation upon them were indicated by stakes and cards, and every thing gave evidence of thrift and skill and scientific management. What capital roads! Nothing but a royal decree could have lined them every where with cherry and apple and pear-trees, stretching away as far as the eye could reach. No fences mar the open landscape, either along the highway or on the division lines. There is a little footpath that leads through the woods, a beautiful, shaded walk to Kleinhohenheim.

Conducted on the same estate, and under the same general direction, the Royal Institute at Hohenheim consists of:

1. The institute or school of agriculture, for young gentlemen.
2. The school of forestry.
3. The school of practical farming, for the sons of peasants.

The lands, plantations, gardens and nurseries connected with the old chateau (eight hundred and twenty-five acres,) are wholly devoted to the purposes of the three establishments, and serve professors as well as pupils for illustration and experiment; while the extensive royal forests (over five thousand acres,) in the neighborhood and lengthy excursions made every year, give a wide range of observation, especially for students in the management of forests.

#### HISTORICAL DEVELOPMENT.

The Agricultural Institute at Hohenheim originated, in a measure, from the establishment of the agricultural society of Wurtemberg, in 1817, when the necessity of a model farm and an institute of instruction and experiment became strikingly apparent, as a means of the development and the elevation of agriculture in the estimation of the people.

The success and popularity of the school founded in 1806 by the illustrious Thaër, at Möglin, in Prussia, had no doubt contributed largely to this feeling among the agriculturists of Wurtemberg. Thaër's enterprise was undertaken at first on his own private account, and so continued till the year 1819, thirteen years after its commencement. It so happened that the introduction and spread of fine-wooled or Merino sheep into Northern Europe, and especially upon the farm at Möglin, near Berlin, concurred to attract to this private effort a large share of public attention, while the reputation of Thaër rapidly grew at home and abroad, not only as a consequence of the success of his school, but likewise from his valuable publications. His school was therefore taken under the patronage of the government, as a royal academy, but the management of the estate still remained at the risk and expense of the owners, the instruction only being paid by the government. This led to a mixed arrangement, the evils of which very soon began to develop themselves, and in time to be avoided at Hohenheim, where the whole establishment was taken under the control of the government, and located upon a royal domain.

A part of this domain happening, at that time, to be under lease, it was necessary to begin the instruction on the small adjoining estate of Carlshof, consisting of only two hundred and fifty-five acres. A small beginning was therefore a matter of necessity, and this was to continue till the year 1822, when the broad estates of Hohenheim would be at the service of the institute, at the head of which stood Schwerz, who was placed by the confidence of the king in full control of the property, with only the assistance of a farm inspector and two of his pupils. He assumed direction in 1818, with eight pupils,



personally arranged every thing, and even managed the finances of the school, which, for the first two years, remained on this simple foundation, as a purely agricultural institute.

In the year 1820, the school for the management of forests, which had previously existed at Stuttgart, was removed to Carlshof and placed under the direction of Schwertz, though still independent for all the purposes of instruction. The greater number of students were then, as they are at present, students of agriculture,—one hundred and twenty-four agricultural students and but thirty-seven foresters.

The limited number of foresters may be owing in part to the rigorous conditions of admission to the forest school, the applicants for which must have practiced in the management of woods for at least two years under a head steward of forests. It was thought that a general connection of instruction in forestry with that in agriculture, would have some important advantages, as, for instance, for the pupils of the agricultural institute, who are either owners, or to become in future, stewards of large estates, in which the management of forests, would often be of great importance, while the contact of a class of students who have to submit to a rigid examination on which their future success will largely depend, would be very useful, as an example of good conduct and studious habits, to students in the agricultural institute who are not obliged to work. It would be a desirable stimulant to exertion. Then the union would enable the two to give a wider range to the instruction in both, the students of each having an opportunity to avail themselves of lectures, which they could not otherwise have, so that the foresters, for instance, could get a general knowledge of agriculture, which they would not gain in a special school.

Experience has accordingly justified this change, and the arrangement still exists.

The School of Practical Farming, *Ackerbauschule*, was begun at the close of 1818, with ten stout boys of fourteen years of age, from the orphans in Stuttgart and other cities. These boys had but one instructor, who had to keep them at work and train them to the greatest possible activity, order, and good conduct. They received to some extent the theoretical instruction of the students in the higher institute, but in 1824 they began to have more or less theoretical instruction adapted to the capacity of each, and to their future designs. This practical school was modified in 1829, when the number was extended to twenty-five, and instead of taking orphans as heretofore, the sons of peasants especially were to be admitted, between the ages of sixteen and eighteen, who, as they were already familiar with the ordinary routine of farm work, could be immediately useful on the farm, and taught the improved processes of agriculture in a shorter time.

They are required to spend three years at Hohenheim, and must be natives of Wurtemberg. Their instruction in the theory of agriculture is limited to two hours a day.

#### SPECIAL COURSES.

Besides the regular instruction in agriculture and forestry, there are several special courses.

1. A school of gardening was established in 1844 at the same place, but still

independent of the others. Six pupils only were admitted into this, and each must have attained the age of seventeen years. Each applicant must have spent three years as gardener or vintager, or attended the course at a farm school, and the garden school aimed in one course to perfect what had previously been begun in the art of gardening and fruit culture. Then, in addition, there were established at the same place, special courses for orchardists, meadow husbandry, shepherds, and school teachers.

2. The course for orchardists, which has been continued since 1850, was designed for young men of eighteen years and upward, who wished to prepare themselves for managers of the fruit trees belonging to the communes or parishes, of which there are immense numbers every where around the villages and highways of the kingdom. This course lasts from four to five weeks in the spring of each year, and a few days later in summer for practice in grafting. On account of the crowd of applicants to this course, in the last few years, from all parts of the kingdom, it became necessary to extend it to three courses a year, with from fifteen to twenty pupils in each, so that now this theoretic and practical instruction in fruit culture continues from the middle of March to the end of May, and a continuation of the course occurs also in August.

3. The five weeks' course upon the technical management of meadows, has been continued regularly in the spring since 1855, whenever there has been a sufficient number of applicants. It includes the art of treating meadows, field drainage, the establishment of boundaries or practice in applied geometry, for those who wish to perfect themselves in farm engineering. The number of attendants on this course has averaged eight.

4. The course of instruction for shepherds was opened for the first time in 1855, and has continued uninterruptedly since, with an average of ten to twelve attendants. Applicants are required to be over twenty years old, and to have been in practice with shepherds four years. The course takes place in February and last four weeks.

5. To these courses was added another in 1860, for school teachers, which is limited to three weeks in the autumn vacations of the public schools. The principal object is to provide the means of a continuation of their agricultural education, which was found to be needed in many parts of the country. Such teachers only are invited to attend this course as have busied themselves on their own or on the school grounds, with agricultural labors, in the formation of means for improvement in agricultural education. The instruction embraces the whole of agricultural labor, with special researches into the imperfections and failings which appear in different parts of the country. The number who may attend each course is fixed at twenty-five.

Instruction in the several courses is given partly by the regular corps of professors of the institute, and partly by persons from abroad who make a speciality of certain pursuits, who go to Hohenheim for the purpose, and the arrangement is such that the pupils during their stay in Hohenheim are occupied the whole of each day, partly in hearing lectures, and partly in demonstrations in the field, in the stalls, in the collections, or in excursions, and partly in the solution of prescribed tasks.

#### OCCASIONAL COURSES.

In addition to the regular established course, occasional courses are given, as



for instance, in 1853, a course upon silk culture, another on bee culture and on the nursery business. They took place in the afternoon of each Wednesday, from four to six, and were attended by twenty young men, mostly sub-teachers or assistants in the schools. In 1855, another course was given upon silk culture, designed for the pupils of the normal schools, of whom one hundred and thirty-four attended. A similar course of agricultural instruction was given in 1861 for the school teachers in the jurisdiction of Stuttgart, in which fifty-two teachers of the public schools engaged. The lectures were accompanied by demonstrations in the field, and in the collections, an afternoon of each week, and the design was to prepare the teachers for holding evening agricultural schools in winter. And so in 1852-3, on the occasion of considerable changes in the laws regarding distilled liquors, two courses of instruction were given to the revenue officers upon the processes of distilling. One lasted ten days and the other twelve, and was attended by over sixty officers of the revenue who desired the information. And so, also, a vast amount of labor is done, and information imparted in answer to letters and through numerous publications by the professors, all of which widen the circle of influence of the institution.

#### MEANS OF INSTRUCTION.

The means of instruction in the institute proper were limited, as already stated, at the foundation, to a physical and mathematical apparatus, an outfit for the chemical laboratory, and a little natural history collection, for which the queen had contributed a thousand florins, and this was confined strictly to agriculture. Still with the small number of pupils it was made the means of important instruction in special branches. As for the farm, a greatly improved arrangement of lands was adopted over that common in the neighborhood, either then or at present. Schwertz, who was born at Coblenz in 1759, and who was familiar with the agriculture of Belgium, where it was carried on in the highest perfection then known, not only got many improved implements from that quarter, but also a skillful foreman who was acquainted with their use, and could teach it to others.

An implement manufactory formed a part of the design, one that should not only supply the wants of the farm with the best tools, but be the means of introducing the most improved implements into the country, and the institute was extremely fortunate in getting the right man for the place, one who had been with Fellenberg at Hofwyl, as an implement-maker, and who not only answered expectations, but soon won a high reputation for the implement branch of the establishment by the strength and goodness of the work.

In 1852, and each year since, arrangements were made for the purpose of securing a more rapid and general spread of improved agricultural implements throughout the country, whereby master wheelwrights and smiths were provided with an opportunity, by a stay of some six or ten days in the implement manufactory at Hohenheim, of becoming familiar by observation, handling, drawings, models, &c., with the course of business and the manner of manufacture there, and the master mechanic took it upon himself to give the requisite explanations. Up to this time no less than 77 master smiths, and 58 master wheelwrights have availed themselves of this opportunity to perfect themselves in their business.

But as imperfect and defective as were the arrangements at the outset, at Hohenheim, there was one thing that neither the director nor the pupils were in want of, and that was an earnest love for their work, and an enthusiasm for the high reputation of the new institute. It was not the least of the merits of Schwertz that he knew how to infuse such an enthusiasm into all his pupils. Where such a spirit reigns great things are easily developed from small. Forty-five years have now passed away, and from the weak seed then planted a strong fruit-bearing tree has developed its wide-extended branches. From eight pupils in 1818, the number has increased to one hundred and fifty in 1863; and from one great professor the number has grown to twelve.

Among the means of instruction presented at the institute may be mentioned, what has already been alluded to, the whole management of the farm, with its experimental fields, the implement manufactory, the workshops, the forests and hunting-parks, the nurseries, both native and exotic trees, the botanic garden, the library, and the different collections and apparatus designed especially for the purposes of instruction.

The botanic garden was started in 1829, with an area of about ten acres. It was intended to serve the double purpose of instruction and ornament to the surroundings of the chateau. I spent a good deal of time in the various parts of this garden. It is laid out on a generous scale, with an agreeable, park-like aspect; groups of trees, ornamental and useful shrubs, parterres of flowers and lawns well kept. A part of it is devoted to annuals, where an immense number of varieties of wheat and other grains are cultivated; each plot being labeled, so that the visitor may know, without a guide, what each contains. In another part are the perennials, especially those of economical value. A grass garden forms a part by itself, where the different species of grass are cultivated in little clumps, each labeled with its scientific and common name; while an arboretum of considerable extent is, at all times, accessible for students and others.

The library contains four thousand volumes on agriculture and forestry and their auxiliary sciences, and is open twice a week.

The collections are very extensive and valuable, more so than at any other institute of the kind that I visited. They consist of large collections of soils, manures, models of implements, and implements in full size; admirable collections of wools, kept in glass cases, among which are complete historical collections from the sheep kept on the farm for many years back, especially of the most celebrated bucks and ewes; collections of woods, minerals, petrifactions, &c.; collections of seeds of fruits, herbariums, pathological and zoölogical collections, apparatus used in the lectures on physics, the chemical laboratory, &c.

The following is an outline of the course of instruction:—

1. General field and plant culture. This includes a general introduction, the objects of cultivation and the connection of cattle breeding with farm operations; also instructions upon climates, soils, manures, implements, working the soil, multiplication of plants, care of seeds, crops, preservation of farm products, accompanied by demonstrations in the field, the collections of models and machine shops.

2. Special plant culture.

3. Meadow cultivation.

4. Wine, hop and tobacco culture.

5. Fruit culture.



6. Vegetable cultivation.
7. Breeding of general farm stock—embracing domestic cattle and their necessity for man, science of feeding and nourishment, care, uses, multiplication, choice, &c.
8. Horse breeding, including the structure and anatomy of the horse; with the assistance of a large collection of fine illustrations of the different breeds, and excursions made to the various royal studs in the kingdom.
9. Cattle breeding—with demonstrations in the stalls, collections of models and cheese dairy.
10. Sheep breeding, including instruction in regard to wools, demonstrations in the sheep stalls, in the wool and model collections, and in the wool market at Kirchheimer.
11. Swine and poultry breeding, accompanied also by practical demonstrations in the pig-sties and collections.
12. Silk culture—including the care and cultivation of mulberries, the proper buildings, the treatment of silk-worms, &c.
13. Bee culture.
14. Practical agricultural instruction—embracing, in general, the duties of steward, landed property in its political and legal relations, position, climate, soil, farm buildings, &c.; capital, labor, and particularly the organization and direction of a farm; choice of objects, estimation of requirements of manure, statistics, nourishment of plants, choice of stock, rotation, farm system, division of fields, transition from one course of cropping to another, &c.
15. Taxation of farm property.
16. Farm book-keeping.
17. Agricultural technology—this course embraces, a year's instruction upon the manufacture of beet sugar, beer brewing, and the distillery of brandy in the winter term, and the manufacture of vinegar, starch, the grinding of meal, tile and brick-making, and wine and cider-making in the summer term, with the innumerable details connected with each.

The auxiliary branches include:—

1. Arithmetic and algebra.
2. Theoretical geometry.
3. Trigonometry.
4. Practical geometry, which includes surveying, land measuring and leveling.
5. Estimation of the value of forest lands, beginning with the cubic contents of timber, the growth of single trees, whole forests, &c.
6. Mechanics and physics.
7. Chemistry in the winter term, general in the summer, agricultural chemistry, with practice and experiments in the laboratory. The lectures on agricultural chemistry treat, among other things, upon the composition of feeding substances, the theory of feeding, &c.
8. Introduction to geology, the object being to give the student a full knowledge of all those minerals alluded to in the lectures on special geognosy, and which are of more or less importance as elements in the soil, and in organic bodies.
9. Geognosy, science of minerals, composition, adhesion, hardness of rocks, their contents of water, air, warmth, &c. Structure of masses of rocks, groups, systems, &c.
10. Introduction to botany and special economic botany, in connection with which weekly excursions are made during the summer, in the neighborhood of Hohenheim, in addition to which are demonstrations in the botanic garden and the collections.
11. Physiology, anatomy and pathology of plants—their anatomical composition; elementary organs—the different forms of cells: the compound organs, the structure of the root, the stem, the leaves; microscopic demonstrations—life of plants in general, assimilation, secretion; chemical composition of plants—the elements, organic and inorganic; the external conditions of plant life—influence of heat, light, and electricity on plants &c.; internal conditions of life. A pathological collection and a good microscope are constantly used in the demonstrations.

12. General zoölogy, with explanations by skeletons.
13. Special zoölogy, with constant use of the zoölogical collections, in classes, families, breeds, &c.
14. Veterinary science, including the structure of domestic animals, with practical demonstrations.
15. National economy.
16. Laws relating to forests.
17. Agricultural mechanics—building materials, foundations, structures, &c.
18. Drawing of plants.

These courses are so arranged that the pupil can go over their whole range in two terms, or one year, if he has had sufficient preparation at the outset; but generally it requires the regular course of two years of the institute.

The course of instruction begins on the first of October, and the first, or winter term, continues till the tenth of March, when there are three weeks' vacation, after which follows the summer term till the first of September. An examination takes place at the end of each year before the royal commission, when prizes are distributed to such as have distinguished themselves by industry, good conduct and acquirements.

The corps of instruction was constituted as follows in 1864:

Dr. Riecke, professor of mathematics and physics.

Karl Siemens, professor of agricultural technology and head-director of the implement manufactory.

Dr. Fleischer, professor of geognosy and botany, and director of the botanic garden.

Dr. Nördlinger, principal teacher of forestry, and steward of the hunting grounds at Hohenheim.

Dr. Emil Wolff, professor of chemistry, and director of the agricultural chemical laboratory.

Dr. Rau, professor of agriculture, who lectures upon agriculture in general, plant culture, meadow management, vine, hop and tobacco culture, breeding of cattle, sheep, and smaller animals.

Dr. Rueff, professor of veterinary science, who lectures upon zoölogy, horse-breeding, and silk culture.

Professor Fischbach, second teacher of forestry and steward of the forests at Denkendorf.

Besides these, there is a teacher of book-keeping, another of national economy and the laws of forests, a director of the garden school, who teaches fruit and root-culture, and a head-teacher, Mr. Kik, manager of the farm-school, who gives instruction in bee-culture. The farm inspector also conducts some agricultural exercises on the experimental field.

These professors are appointed by the king, upon presentation to the Minister of the Interior, made by the general council of agriculture.

The salary of the professors, like the pay of scientific and literary men generally in Germany, is very small, scarcely adequate to their support, even on a very economical establishment. This accounts for their prolific pens. They are compelled in very many, no doubt in the vast majority of cases, to write books, prepare articles for the scientific journals, and otherwise to eke out the means of a respectable support.

The salary of the director amounts to 2,500 florins, \$1,025; that of three professors, each 1,500 florins, \$615; one professor has but \$533; three others have \$492 each; another, \$348; two assistant teachers, each \$102:

The students of the higher institute are admitted, after the age of eighteen, without examination, on certificate of willingness on the part of parents, and of industry and good conduct at the schools hitherto attended, and at any time during the year, and are held to no very rigid discipline, being required to attend three of the regular courses every week, which they may select.

The lectures begin at six o'clock in the morning in summer and at seven o'clock in the winter, and end at seven o'clock in the evening throughout the year. They continue with only two hours' intermission for dinner at noon. Two lectures, for different sections, are often going on at the same time.



## INSTRUCTION IN DRAWING IN WURTEMBERG.\*

In response to numerous inquiries from foreign governments, in regard to the system of public instruction in drawing in the popular schools, real-schools, and trade improvement schools of Wurtemberg; an investigation was ordered by the Ministry of the Church and of Education. The results of this investigation in regard to the teaching of this branch, so important to the industrial development of the country, we now proceed to lay before our readers.

COMMON OR ELEMENTARY SCHOOLS, (*Volksschulen*.)

Drawing forms no part of the plan of instruction prescribed by the government (Sept. 29, 1836) for these institutions, but is every where an optional branch, and its introduction into the school depends upon the action of the local authorities. The sole exception to this, is the case of seventeen of the so-called "middle schools," of the Protestant denomination, where it is obligatory. These are *Volksschulen* with a somewhat enlarged curriculum. Apart from these, drawing lessons are given out of the regular school hours, on the half-holidays, Wednesday and Saturday, and in some places, on Sunday, two hours in the week being assigned to them. In the country, these lessons are given during the winter only; in cities in the summer also. No pupil is admitted to them before his eleventh year.

In 1866, instruction in drawing was given in connection with 184 popular schools of the Protestant faith, and to 5,767 pupils, for the most part boys. Of those belonging to the Catholics, the number had risen to 134 at the beginning of the year 1868, (Jan. 1,) 25 of which were in the larger cities, (*Oberamtstädte*,) 18 in smaller cities, and 91 in the villages. In some of the smaller parishes of the cities, (*Stadtgemeinde*,) the pupils of the Latin and popular schools unite to form a class in drawing, these being the only cases in which different institutions unite for this purpose.

There is at present (1868,) no prescribed graded and methodical system of teaching this branch, the thoroughness of the instruction being secured, however, by regular inspection and certain extraordinary drawing courses for the teachers, to be described farther on. Linear and free-hand drawing is taught, and in some boys' schools of an advanced character, geometrical drawing also.

The teachers employed are the drawing-masters of the trade improvement-schools in those cities where such a special class of instructors is employed; where this is not the case, and in the country, that regular or irregular teacher in the primary schools who is best qualified for this purpose.

In regard to the salary, extra pay for this service is generally given by the commune, for which purpose it receives a certain annual subvention from the Government, only, however, in years when the exhibit at the treasury is favorable. In the villages this extra pay amounts to about twenty florins (Rhenish,) but is proportionably greater in the cities, where however the duties of teaching drawing and the additional pay are very often connected with the trade improvement schools. In some parishes, there is no extra pay, and the hours of drawing lessons are included in the thirty hours per week required of the teacher.

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\* From the Supplement to the Wurtemberg *Staatsanzeiger*, May 22, 1868.

The preparatory instruction for the teachers of the popular schools is generally imparted during the regular course at the normal schools. Since 1860 this course has been extended by the addition of a three to six months' drawing-course to the regular period of study, to be free of expense to the twelve most gifted members of the class. The continual improvement of the teachers is secured by the following arrangement. Every year there is held, in different cities, terms of four to six weeks under the charge of the best drawing-masters, to which those teachers in the popular schools are summoned who either have already given drawing lessons or are about to begin them. The instructions of those to whom these classes are confided are that they are not only to recall what has already been learned by their pupils, but to assiduously endeavor to improve their method of drawing. They receive suitable pay from the government, and the teachers summoned to attend are allowed 1 florin and 20 or 30 kreutzers daily for their traveling expenses, from the same source. The system has worked admirably, particularly within the experience of the Catholic school authorities (*Oberschulbehörde*.)

The cause of drawing-instruction in the popular schools has been very essentially furthered by the biennial visits of inspection to which they, as well as the real and trade improvement schools, have been subjected. This inspection is conducted in the following manner. On the day when the visits of inspection of a real or trade improvement school are made, all those teachers of the popular schools in the surrounding district where drawing is taught, resort thither, in order to lay the work done by their pupils before the Commissioner, who examines them and points out their defects, giving such advice, correction and instruction as may seem to him demanded in the several cases.

The Commissioner reports to the upper school authorities, especially in regard to those teachers who, in his opinion, should be summoned to the above-mentioned courses. Another incidental benefit of the labors of this Commissioner is that the school authorities have prevailed upon those communes not provided with the proper helps (books, &c.) to instruction, to procure them. The great drawing-book of Professor Herdtle, with explanatory text, has been introduced into all the Catholic and most of the Protestant schools, this being partly due to the Central Board of Trade and Commerce, by whom the publication of the work was undertaken, and by whom it was distributed to the poorer parishes, half or all of the price being deducted. The studies of Deschner in Heilbronn are also used, having been commended for some of the schools by the inspectors, and the old, imperfect studies are every where laid aside.

The further experience of the inspectors will soon be sufficient to justify the fulfillment of the plan, now being perfected, of publishing an elementary and properly-progressive work, containing such studies, both for free-hand and linear drawing, as shall answer the wants of the popular schools.

#### REAL-SCHOOLS.

As in other branches of the real-school course, there is for the drawing classes a different organization in the different orders of institutions, namely the lower, with one, two or three classes, which include pupils as far as the fourteenth year, and those with seven or eight, with pupils between eight and sixteen years of age, giving special preparation for the Polytechnic. In the latter, the higher real-schools, each of the first six classes covers a year; the seventh



and eighth, each the same, two years, namely from the fourteenth to the sixteenth. The real-schools with three classes begin with the eighth year, and give two years to each class successively; those with two, at the tenth year, and give two years to each class, while those with one class extend from the eleventh to the fourteenth.

In all these schools, instruction is given in both geometrical and free-hand drawing. It is in every case considered an essential part of the course, and those communities among whom any branch of industry has been developed to a certain degree, regard it as particularly important, and foster it with jealous care.

The regular age at which the lessons are begun is eleven, as it is considered that the defective development of the physical and mental organization would render an earlier introduction to the study fruitless, which, indeed, experiment has shown to be the case. The pupil is first initiated into free-hand drawing.

The courses are continued until the pupil leaves the school, making the number of years five in the higher institutions, and three in the lower. In the former, four hours in the week are given to the subject; in the latter, three, although in particular communities, one hour more or less is the rule, according to local circumstances.

Geometrical drawing is commonly entered upon a year later, and is pursued during two hours a week, except at the very first, when another hour is appropriated in order to secure the laying of a good foundation. This branch is, however, not pursued in the one-class schools, which are generally located in the poorer parishes, and in which one teacher has the simultaneous charge of several divisions.

The aim is very diverse in the different institutions, since there is no one of the branches of study in which the different capabilities of pupils are so evident as in this. Instruction addressed to all of them at once is possible only at the very beginning. For with every step in advance, the special talent of each becomes more prominent, and the task of the teacher then is to pay that attention needed in each individual case, without neglecting those explanations which ought to be addressed to the whole class in a body. But the difference in the character of the assistance in different cases, is less objectionable than in other departments of instruction.

In regard to progression in the lessons, and the end to which it is sought to conduct the pupils, the following may be considered as a fair average example of the method adopted in different schools:

#### A. Free-hand Drawing.

(a.) *From studies*.—1. Elementary free-hand drawing. Simple, plane, rectilinear figures; simple, elegant outlines of leaves, vessels, and other objects, for the most part from drawings made on the blackboard. 2. More difficult outlines from studies; parts of the body, heads, &c.

The object aimed at in working from studies is a correct outline.

(b.) *From casts*.—3. Outlines from reliefs. 4. Shaded drawings from reliefs; for practice in shading, studies are used. 5. Outlines and shaded drawings from casts.

The aim is, in this part of the course, the correct drawing of a cast in point of light and shade.

The higher real-school can conduct pupils through the whole of this course,

but in the lower class of institutions studies only are used, and with these the instruction is often carried no farther than the first part, the copying from drawings on the board. The copies most used are those in Professor Herdtle's work, as edited by the Royal Trade School Commission.

#### B. Geometrical Drawing.

For details upon progression and the aim given to the courses, the reader may consult the "Programme of Instruction in linear drawing in the classical and real-schools of Wurtemberg," by the Upper Councilor of Studies, Fischer.

The aim of this course is to give the pupil certain information, skill and habits, and to cultivate his taste. He is therefore (1) to learn geometrical terms, that he may understand a drawn and explained geometrical figure; (2) to cultivate order, neatness, exact and neat execution; (3) to acquire sureness and rapidity in the use of instruments, and in the application of practical points intended to facilitate certain processes (*praktische Handgriffe und Vortheile*;) (4) to become acquainted with the rectilinear and curved geometrical figures, the knowledge of which is particularly important to an artistic, scientific, technical or æsthetic cultivation, in regard to their elements and the modes of drawing them. The subjects of instruction include, therefore, on the one hand the elementary exercises, as drawing a straight line through two points, continuing and equally dividing straight lines, drawing parallel lines, describing circles and arcs, bisecting arcs and angles, drawing perpendiculars to other lines, using the protractor and reduced scale, drawing tangents, constructing equilateral triangles and regular polygons, &c.; on the other hand, the complex figures which are formed by combining the lines, angles, &c., studied in the elementary exercises, and arranged as follows:

(a.) Figures may be executed with the ruler or compass in such a manner as to necessitate the use of the free hand to complete them, the direction of the lines being indicated by points or tangents.

(b.) All problems should also be exhibited in a completed condition, to afford the means of comparing the pupil's work.

(c.) They ought to clear up difficult points in scientific geometry, or present forms important in industry, or ornaments drawn from classic, Gothic or Arabic work. The teacher, by properly placing and explaining the studies, by watching the pupil during his work, by criticising each completed piece, and by careful direction of individuals in regard to the minutiae of their tasks, must conduct and give animation to the work as a whole or in parts.

The stages of the course are—

1. In the first, easy figures, with application of the first elementary exercises, are drawn in pencil, and shaded with India ink. (Three months, but longer if the study of geometrical forms is entered upon.)

2. In the second, larger sheets of paper are provided, and the drawings are completely shaded with India ink, care being taken to distinguish the different lines. (One year.)

3. The figures drawn in the third stage call for the use of all the various elementary operations; they are always connected with higher geometry; the pupil is allowed to make use of a text, or, where necessary, of a sketch. (Nine months.)

4. In the fourth stage, the pupil is required to construct certain figures, of which he has the measurements only, or perhaps some few explanations from



the teacher. These are geometrical studies particularly useful in drawing, the reduction of figures to another scale, the measurement of angles by employing continued fractions, regular quadrilaterals, the higher theory of circles, determining the centre of gravity, ornaments, Gothic carving and inlaying, rosettes, &c. He is to draw these by methods based on his own scientific knowledge, or from empirical means invented by himself.

5. The fifth grade embraces (a) higher curves, to be constructed, produced, provided with tangents, &c., by the pupil himself; (b) drawing of plans; (c) ground and outline drawing, with a constant view to parallel perspective.

The fourth and fifth grades are reserved for the upper real-school.

The text-book used in these exercises is the collection of studies for geometrical drawing by the Superior Councilor of Studies, Fischer. There has appeared (1867) a third edition of this work, although it is not yet completed beyond the third grade of the course; it was drawn up on commission from the Department of Classical and Real Schools of the Ministry of Religion and Education. Of course other means to illustrate the course and assist the teacher are not excluded.

Both the collection of studies for free-hand drawing published by Professor Herdtle, on commission from the Royal Commission for the Trade Improvement Schools, and the last named collection of studies, have been published and their method particularly recommended. Since, however, general instructions are much less valuable than proper personal suggestions in which the merits of the method of the teacher addressed are recognized, and his errors pointed out, regular visits of inspection have been offered.

The arrangement of the rooms where drawing is studied varies much, according to the pecuniary circumstances of the communes, since on them falls the greater part of the expenses of the real-schools.

Sometimes the ordinary school-room is used without particular preparation of the desks, or with certain provisions, frames to hold the copies or models being placed upon the lower tier of seats or in some cases let down from the ceiling. In all the higher real-schools and many of the more important of the lower class, special rooms are provided for the class, with a northern light, many and high windows, so arranged that a regulated light shall fall from the left without interruption upon the work of each pupil. The plan of the room is such that the teacher can get at any one without disturbing the others. The drawing is done at small tables, or, in case models are used, broad tables, with curtains provided to make a suitable background. Three-legged stools are used for chairs, and simple supports are provided upon which the paper can be laid.

The communes receive assistance from the State, which gladly contributes a larger or smaller sum, according to the needs of the case, towards fitting up these apartments.

The instruction is generally intrusted to the principal teachers, (*Hauptlehrer*), each professor teaching his own pupils, or the most capable in the whole corps instructing several or all of the classes, exchanging with the others some of the other branches previously taught by him.

In all of the higher real-schools, however, and in some of the lower, especially in cities where the need for instruction in this branch is felt by those not members of these institutions, and evening and Sunday improvement-schools

are founded, specially educated drawing-masters are engaged, who either devote their whole time to the school, or, and this is often the case when they teach only one branch of the art, fill some other profession at the same time, as that of architect or artist.

The training of the teachers is most commonly obtained at the Polytechnic, sometimes also at the university. It is part of the examination of the candidate for a teachership in schools where realistic branches are taught, he being required to show—

1. In geometrical drawing—skill in the use of instruments and in the execution of geometrical drawings. He is besides required to execute a drawing, solving some problem in descriptive geometry, with the addition of a designation of the process of solution.

2. In free-hand drawing, he must be able to execute correct and elegant outlines from models, and must understand the treatment of shading. He must at the same time exhibit a portfolio of drawings from his own hand, and give oral explanations in regard to them.

Improvement courses are instituted for those teachers who need them, held during the holidays or during furloughs granted for this purpose, extending from six weeks to several months. They must devote all this time to study at the Polytechnic, the winter building school, or in the so-called open drawing-rooms, which are fitted up in several cities to meet the needs that may arise in the local industries, and are under the supervision of the professors or superintendents there stationed. For this purpose they receive a varying subvention from the Government. They are directed not only to cultivate their own skill in drawing, but to acquire the art of conducting a course in a properly progressive manner, and to do this they must visit the drawing-schools held by the best teachers and the different classes for pupils of different ages.

The correct and advantageous method secured by these means is carefully regulated and supported by regular biennial, or, where necessary, annual visits of inspection ordered by the Department of Classical and Real Schools, in conjunction with the Trade Improvement Schools Commission. Every teacher sends, in response to a certain special scheme of interrogations, an annual report, containing a full catalogue of his pupils, a report of their general progress and what they have accomplished, of the obtaining of new apparatus for which there is special provision in the budget of the commune, details in regard to his own studies, changes in the school-rooms, and all similar matters. This report is placed in the hands of the inspector before his visit, in order that he may use it as a basis for determining the condition of the school and the results arrived at; he then adds what he himself has observed and the changes which to him seem necessary, addressing his remarks to the upper school authorities, who then take the proper steps. The inspectors are taken from the most excellent drawing-masters in various institutions, but the inspector of the scientific studies in single schools may always, if he chooses, examine the condition of instruction. The visits are always previously appointed, the place and day being indicated in a scheme published at the beginning of every year. To insure conformity in the inspection system, conventions of the inspectors are held at intervals of several years, to discuss their experiences, and to decide upon the principles which are to guide them in giving corrections and advice to the teachers upon their method, the selection and purchase of apparatus,



their improvement, and similar matters. At this conference are present also members of the upper board. To them is due the impulse whence originated the publication of the studies of Herdtle and Fischer.

As an additional means of elevating and invigorating instruction in drawing, must be mentioned the exhibitions of the works of pupils, held for the most part at the close of the tour of inspection or of the school-year, and by limited districts or occasionally by the whole country. They serve the purpose of awaking the interest of the public, especially that part of it engaged in industrial occupations, to bring what has been accomplished by single teachers before the eyes of their colleagues, to arouse a healthful emulation among them, and by the more or less numerous attended conventions of teachers held in connection with them, to afford the most rapid means of rendering universal all improvements in the system of instruction.

#### TRADE IMPROVEMENT SCHOOLS.

Instruction in drawing is given in all of the trade improvement schools, of which there are at present (1868) 122. The number of hours per week given to this branch differs at various places from one and a-half to forty-four, the last being the case at the evening improvement school at Stuttgart, and the minute division of the courses affords to the single pupil the most unbounded opportunities for taking part. In many of the smaller country schools, drawing is taught only on Sundays, before and after church service; in other schools, partly on Sundays, partly on week-days, partly on both, always in the evening, and in some institutions it is prolonged throughout the whole year, although scientific instruction is, in these establishments, given during the winter months alone. In fifteen of the most prominent improvement schools, which have their own drawing-masters, there are so-called "open drawing-rooms," (*offene Zeichensäle*,) where the teacher remains during the greater part of the day in order to oversee those pupils who wish to spend the whole day in drawing or modeling, and to give advice to proprietors of industrial establishments in matters connected with art-work.

The course varies, in different localities, according to local circumstances, especially in view of peculiar industrial needs. General remarks must be limited to the following:

*Free-hand drawing.*—In this department the pupil begins with thorough instruction in drawing outlines from Professor E. Herdtle's book of elementary free-hand studies. When the beginner has had sufficient practice in this, he goes on with shaded ornament drawing after Weitbrecht, or after French studies, and when he has had a little practice in shading, passes to plaster models taken from the elementary series of the illustrated catalogue of the Royal Commission. The mode of further progress depends upon the particular character of the pupil and the ability of the teacher to conduct him farther. In many cases the attempt to conduct him as far as inventing art designs for manufacturers has proved successful, which is the ultimate point to which free-hand drawing is carried in the trade improvement schools.

*Linear drawing.*—Instruction in linear drawing is parallel to that in free-hand drawing, and must be preceded by the study of geometrical forms unless the pupil is already acquainted with them. He is not to pass into the study of design as connected with particular employments, until he has become acquainted with geometrical drawing.

*Technical design (Fachzeichnen.)*—The study of design as applied to particular industries is, in the larger schools, preceded by a course of perspective. It is exceedingly varied, since every pupil seeks that which he will need in his own future employment, and in the larger schools, such as those in Stuttgart, the course is divided into many specialities, particular courses being given for builders, mechanics, saddlers, locksmiths, &c., by persons connected with those branches of trade, and with great success. In order to satisfy the great demand for proper studies for these various departments, the Royal Trade School Commission has ordered such to be prepared for builders and furniture-makers, and for locksmiths and mechanics. These can be obtained at W. Nitzschke's, in Stuttgart. Additional studies for special trades appear from time to time. Very useful are the studies for mechanics, by Rössler and Fink, published at Darmstadt; also the *Gewerbehalle* of Bäumer and Schnorr, published by Engelnhorn at Stuttgart, sometimes contains very useful studies, so that this journal is taken at all the more important drawing-schools in the country.

Instruction in modeling in clay, wax, plaster or wood is, in most of the trade improvement schools where there are capable teachers, given together with the drawing lessons. In this branch many of the schools which are connected with industrial establishments, and where sufficient time is allowed, have accomplished much.

In order to provide more apparatus for the drawing and modeling schools than can be obtained in the regular market, the Central Board of Trade and Commerce has added a special workshop for models to the collections at the Royal Industrial Museum; here are prepared the models figured in the above-mentioned illustrated catalogue. There is also, besides the library connected with the Museum, a circulating library, (*die sogenannte Wanderbibliothek*,) consisting of technical and art works of all classes, which are sent free to teachers at their request, and allowed to be used by them for a considerable period of time.

The instruction is imparted in most cases, especially in the smaller improvement schools, by the teachers of the elementary and the real-schools, who receive special pay for this extra service. In larger schools, the architects of the cities undertake to give instruction in technical design. In about twenty cities, regular drawing-masters are provided for the improvement schools, to whose superintendence the above-mentioned open drawing-rooms are intrusted. The pay varies much, according to the circumstances of the locality and of the individual; however, the just principle every where prevails that the pay for instruction given in the day-time shall not be so high as for evening lessons, since these are far more fatiguing. Teachers who give drawing lessons in addition to their other occupations, receive from 40 kreutzers to 1 florin 20 kreutzers the hour, while the salary of the regular drawing-masters, who must be in the school-room the greater part of the day, reach from 600 up to 1,200 florins. According to article 3 of the law of February 18th, 1868, concerning the legal conditions of those connected with the service of the Department of Church and School, it is possible that pensions will be allowed to instructors of the last class.

The improvement of the teachers is, in the case of those from the elementary and real-schools who give instruction in the improvement schools, secured by the plan already detailed. In many cases a particular method has for several



years been adopted with great success, to obtain drawing-masters with special preparation for teaching technical drawing. This is, that young people of talent are enabled, by proper assistance from the State treasury, to study at the Polytechnic or at art-schools, generally for a term of years, during which period they spend a certain time, about the half of every day, in a workshop devoted to some artistic branch of industry. Experience has shown that this combination of æsthetic cultivation and practical art employment is very successful, since these teachers, who during the period of their artistic cultivation stand in close contact with practical industrial life, are particularly well adapted to exert upon their special trade an elevating influence.

The rooms for instruction in drawing are generally the usual school-room, frames to hold the studies being placed on the lower tier of benches. In the larger improvement schools, however, rooms are specially devoted to the purpose, being provided with drawing-tables, seats for modeling, and arrangements for drawing from the cast. Those institutions not possessing such rooms make every endeavor to obtain them, since methodical and successful instruction can be given only when the rooms are properly arranged. For evening instruction the apartments are lighted with gas or petroleum, experience having shown that there is no difficulty in drawing from casts in this light. For those communes who are to fit up new localities, a model plan has been drawn up and distributed by the Royal Commission of Improvement Schools.

The inspection of the drawing courses in the improvement schools is regulated in connection with that of the real and elementary schools. The inspectors for all three classes of schools are the same, and the mode of proceeding is essentially the same as already detailed in the preceding cases.

#### *Triennial Exhibition of Results.*

The triennial exhibitions at Stuttgart of the works of the pupils have been found very useful in elevating the character of the instruction in drawing and modeling. The different institutions of the country are represented in this exhibition. Not only does the Board of Inspection gain a vivid idea of the character of the instruction imparted in individual schools, but the teachers, who are all summoned to be present, have the opportunity of comparing the efficiency of their teaching.

A convention is held at this time in which the exhibition is discussed, experiences and criticisms interchanged, and improvements suggested. The communes also, who send many of their representatives to the exhibition, become more zealous as they see how much other communes have accomplished, learn to appreciate the value of a knowledge of drawing, and especially become convinced how much can be done in the evening courses, and are ready to make sacrifices for the improvement of their schools to which they would otherwise not easily have been induced.

## MUSEUM OF INDUSTRIAL ART.

In connection with the Royal Institution for Trade and Commerce at Stuttgart, there has been established a *Museum of Industry*, with the general aim of improving the industrial condition of the country by exhibitions of machinery, the rough material and modifications made by manufacture, and at the same time afford facilities for study accessible to workmen and the public generally. It embraces:

1. A Museum proper, which is rich in specimens of German and foreign manufactures, and with specimens and models of useful machines and implements, designs for ornamentation of all kinds, arranged in a systematic manner according to the various trades—for mechanics, builders, joiners, coach-makers, workers in ivory, bronze, all kinds of metals and earthen-ware, needle-workers, weavers, book-printing, photographers, etc. etc.

2. A Trades' Drawing School, which artisans can attend, using the collections for their own special calling, and also to enable teachers to perfect themselves in the various styles of drawing, especially the industrial. Instruction is given without cost to those who wish to use the acquisition in their own professions.

3. A Chemical Laboratory, which is annexed to the exhibition for the purpose of making experiments in analysis of ores, or in testing colors or any new discovery, or in any application of chemical agents or processes to the arts.

4. A Library and Reading-room; the first embracing the most expensive and most recent publications connected with art, commerce, and manufactures; and the last supplied with the leading periodicals in different languages relating to industrial and economical subjects.

5. A Weaving School, in which there are almost every variety of loom, the uses of which are explained, and facility in their management acquired.

6. A System of Loans, by which any movable specimen, model or design can be sent to any part of the kingdom to be studied or copied.

The institution, in all its departments, is accessible to artisans without cost, and to any visitors by paying a trifling fee. It is much resorted to by workmen, and its various models, and patterns of printing, embroidery, and weaving, and illustrated books, are loaned to manufacturers in different parts of the kingdom, several copies of such as are new or in demand being secured, that their immediate use in the institution may not be abridged. The institution has an annual grant of 90,000 florins from the government, to be expended in new acquisitions.



## SYSTEMATIC TECHNICAL EDUCATION.

*Illustrated by the Example of Wurtemberg*

With the above title,\* J. Scott Russell, Esq., a member of all the prominent societies of Science and Art in England, and who has had large opportunities of forming a sound judgment on the subject on which he writes, has addressed a volume to the Queen, and through her to the People of England, on the necessity of a systematic technical education to continue the country of his birth, his residence, and his labor—the country of his pride and his hopes—in the way of a permanent progressive development in material, moral and intellectual well-being. The author fortifies his arguments and draws illustrations mainly from the experience of Wurtemberg and Switzerland, and introduces his condensed and tabulated statement of the technical institutions of the former kingdom by the following remarks :

## INTRODUCTION.

I WILL now proceed to develop in their practical details the organization of the great institutions with which foreign nations have been provided by their Governments for the technical training of their youth. It will be highly instructive to notice how these great educational colleges extend over all the divisions of society, high and low, embrace every kind of occupation, and aid every branch of industry. As the example of an educated nation, I might have taken the symmetrical and perfectly organized institutions of Prussia, or those of a country boasting a personal freedom equal to, or greater than our own, like Switzerland. But I think it may be more useful to us to see how much more is done than in our country by some of the smaller unpretending States; by some one of those little kingdoms of which we English know little, care less, and rather despise. I might take Nassau for example, or Baden, or Hanover, and show how these countries have been covered by a network of institutions for the intellectual nutriment and moral training of their subjects, and how I have found in them all a degree of intelligence, culture and moral well-being, which have seemed to me admirable and enviable.

But the nation which I select for the purpose of this Chapter shall be Wurtemberg; I select it as a model nation on a small scale, and therefore more easily studied and more readily comprehended; and as it contains only a population of 1,700,000, or one-twelfth of England, or one-twentieth part of the United Kingdom, we can readily see what would be the proportion of similar institutions in England or Great Britain which should enable us to say, by a simple act of multiplication by twelve or by twenty, what would be the number of technical universities, trade colleges; and craft schools, which would provide as well for the people of Great Britain as the little kingdom of Wurtemberg has already been long provided for.

These model institutions of the kingdom of Wurtemberg have the

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\* *Systematic Technical Education for the English People.* By J. SCOTT RUSSELL, Esq., M. A., Fellow of the Royal Societies of London and Edinburgh; Member of the Society of Arts, the Institutions of Civil Engineers, Naval Architects, &c., &c., &c. London: Bradbury, Evans & Co., 1869.

advantage of great symmetry and continuity. There is at the summit for professional men:—

1. The Polytechnic University of Stuttgart, which is meant to educate the highest classes of professional men. Among these are the modern professions of civil engineers, mechanical engineers, and architects. There is a course for the mercantile and commercial classes. There is a course of chemistry, with its applications of the chemical arts and manufactures, and there is a course of general superior scientific and literary education for professors, lecturers, and men of leisure.

The building appropriated to this purpose forms one of the piles of finest modern architecture in Stuttgart. There are no less than fifty-one professors and teachers, and besides the usual lecture-rooms and studies, there are a chemical laboratory, a physical laboratory, mineralogical museums, laboratories for constructive experiments, plaster-modelling rooms, mechanical work-shops, wood-modelling rooms, rooms for drawing, a botanical garden, and an astronomical observatory. To appreciate the value of such an institution, and its fitness for giving in detail all the preliminary knowledge which a professional man ought to have before he becomes the pupil of the master who will introduce and train him to practical work, the reader must consult the detailed plan of it given at the end of this Chapter.

2. A second, and even more remarkable educational institution, is the school for the building trades, also in Stuttgart. It is a complaint continually made, and with justice, against these technical colleges, that the scale of education is too large, and its quality too ambitious, to form any but the highest class of members of any technical profession or trade; that the more ordinary and numerous members of these trades and professions, who equally require a thorough practical training, find themselves insufficiently educated even to enter the technical university, and without leisure to devote to it the long and continuous time necessary for its courses. A narrower course is wanting for foremen and clerks of works, and even for directors and managers of small sections of trades, and it is desirable that the humblest craftsman should be able to get such education as, with intelligence, diligence, and probity, should enable him to rise to distinction and skill in some one thing.

For these great and wise purposes some of the most distinguished directors of the technical university, after many years' experience of the value of such education to skilled craftsmen, and the incompatibility of giving the highest and broadest education, equally with the narrowest and humblest, in the same institution, represented to the Government the expediency of forming a new school, intended for building crafts and tradesmen of the rank immediately under the professional men and skilled masters of the technical university. That was accordingly established, and succeeded so quickly and so completely, that it became necessary to erect quite as large and as handsome a building, and to devote quite as large a staff to that purpose as to the original polytechnic university; it is now one of the most remarkable and meritorious schools on the Continent. The men whom it was especially designed to help in their trades were stonemasons, bricklayers, and carpenters, to be trained for



future master-builders, lower class builders to be trained for master-builders, constructors of public works, subterranean works, and constructors of reservoirs; constructors of water-works, river-works and mill-works, and land surveyors of the first and second class. The general workmen whose education it undertakes are plasterers, tilers, roofers, joiners and carpenters, glaziers, turners, decorators, ornament-sculptors, modellers, engravers, smiths, gold and silver workers, gardeners, and husbandmen. Its great merit is its perfect adaptation to the wants of each separate class of persons. For young men who are much employed in winter, and less in summer, it provides summer courses of study, and gives them vacation in winter, and *vice versâ*. It has classes in the early morning, the same at mid-day, and the same over again in the evening; and the hours of the different classes are so timed, that the pupil may attend many or few hours of the day, and still obtain the studies he requires.

This school is presided over by the most distinguished architect of Wurtemberg, with no fewer than twenty-eight professors and masters under him. Systematic courses are provided for those who can go through the education required to obtain certificates of competence; and their estimation of its value is proved by the fact that the school is crowded by exactly that class of men whom it was intended to benefit.

3. The next class of institutions are wisely situated not in the metropolis, but in the country, and they are distributed throughout the districts. They are schools for country occupations and trades, and are called "agriculture and forestry establishments."

There is first a great institution at Hohenheim, with twenty-one masters. It is divided into the farming school and the gardening school, and special agricultural courses. It has under it three practical farming schools in three different districts, and each school has under its care 400 square miles of territory. A large brewery is attached to one of these establishments, and there are subordinate schools distributed throughout the country. There are also winter evening schools in the villages, and the practical result is, that last year, in 523 places, 12,040 persons enjoyed the privilege of agricultural instruction.

Supplementary to the agricultural education of the farmers is an institution for the study of the anatomy, physiology, training, and diseases of animals; it is the veterinary college of Stuttgart. Attached to it are an hospital, in which last year 775 horses were treated; a cattle hospital, in which 826 animals were treated; a dog hospital, in which 213 animals were treated; a smithy, in which 4000 animals were shod.

With such upper schools for the technical training of the people, it will be readily imagined that there must be a complete organization of upper and lower schools leading up to them, otherwise these higher schools could not be filled with fit pupils; and as they all require preliminary qualification, tested by an entrance examination, the preparatory schools are indispensable. There are accordingly eighty-eight colleges or public schools, separated into the two divisions of classical and of science schools.

In the classical schools there were last year 4565 pupils, and in the science schools 4734 pupils; showing how evenly the two classes of schools



provide for the two classes of pupils. These are also divided into two subdivisions, upper and lower, called gymnasiums and lyceums; and in the science schools, a school and a college, or *real* school and *science* college.

Immediately below these are the public elementary schools, and establishments for private instruction; and, auxiliary to these, technical schools of the humblest kind, in which girls are taught their business as housekeepers, and boys are trained to the simplest duties of life.

When it is considered that these establishments are for the education of only 1,700,000 people, less than an eleventh part of the population of England alone, without Ireland or Scotland, it leads to the startling conclusion that England, to supply her people with a technical education as good as that of the little kingdom of Wurtemberg, should have 11 endowed technical universities, each with 49 masters and accommodation for 468 pupils, or that in all there should be in the technical universities of England more than 5148 technical students. That we should have 11 building-trade schools or colleges with 26 masters in each, and in each 587 pupils, or on the whole more than 6457 students. Of higher trade schools there are in Wurtemberg 108 in 89 towns and 19 villages, so that to equal that, in England there should be higher trade schools established in 979 towns and 201 villages, making in all 1180 schools. In these schools are 6453 pupils under 17 years old, and 1811 over 17 years old, making a total of 8264 pupils. These are taught by 425 masters. To do as much in England, we should have 4675 masters, teaching 90,904 children.

To know what the enormous sacrifice is which a nation must make to accomplish this moral and intellectual revolution, be it known that the expenditure of the State amounts to 2*s.* 7*d.* per inhabitant!

Probably nothing will convince the English people better of the value of such education than to inspect for themselves the nature of that education, the numbers and classes of people who avail themselves of it, and somewhat in detail what it all costs.

The following statement has been compiled from the accounts of the Minister of Education of Wurtemberg, and will, I trust, enable the Englishman to put a money as well as a social value upon the systematic education which I desire to see given to Englishmen of every profession, trade, and craft:—

*Table of the System of Universities, Colleges, and Schools for Technical Education in the Kingdom of Wurtemberg.*

TECHNICAL INSTITUTIONS.

1. TECHNICAL UNIVERSITY IN STUTTGARDT.

This consisted, in the year 1865-66, of a Mathematical division, with two classes and one merchants' class, and a Technical division with two trade schools.

I. *Teachers:*

20 head-masters, 13 trade and assistant-teachers, 4 under-masters, 6 ushers, 6 private teachers—together, 49.

II. *Scholars and Students:*

A.—In the Winter term 1865-66, 468, of whom 163 were in the Mathematical and 305 in the Technical division. In detail there were—

	In the trade classes.	In detail there were—						Total.
		Cl. I.	Cl. II.	Arch. Sch.	Engin. Sch.	Machinery Sch.	Chem. Sch.	
Natives	16	65	49	76	56	34	52	348
Strangers	16	5	12	21	20	13	33	120
	32	70	61	97	76	47	85*	468

\* Remark.—Of the 85 students of the Chemical school, 31 were employed in the laboratory



Of the 120 strangers there were from—

Switzerland, 20; Austria, 19; Bavaria, 15; Russia, 12; Baden, 11; Prussia and Grand Duchy of Hesse, 6; England, 5; France and Saxe-Meiningen, 3 each; Hamburg, Holland, and Italy, the United States of America, and Java, 2 each; Belgium, Cuba, the Electorate of Hessen, Hesse Homburg, Oldenburg, Palestria, Schleswig Holstein, Sweden, Turkey, Duchy of Waldeck, each 1.

According to the vocation of the fathers there were sons of—

Servants of the State	99
Other public servants	54
Followers of trade, and merchants	201
Followers of agriculture	17
Followers of other professions (artists, doctors, &c.)	97
	468

The average age of scholars and students was, on the 1st of October, 1865, in—

The Merchants' Class.	Cl. I.	Cl. II.	Technical Division.
16 yrs. 6 m.	17 yrs. 2 m.	18 yrs. 2 m.	20 yrs. 2 m.

With regard to preparatory education—

Of the 143 scholars of the Mathematical division, including the merchants' class, there were educated—

At the Wurtemberg real and upper schools	114
At humane institutions (seminaries, gymnasiums, lyceums, &c.)	18
At other schools or private institutions	31
	163

Of the 305 students of the Technical division there entered—

From the Mathematical division	112
From the lower Technical institutions (out of which 40 were out of the Mining schools)	53
From the other Technical schools	27
From other institutions (real schools, gymnasiums, universities)	77
From practical professions (architects, mechanics, apothecaries, lithographers, shopkeepers, officers)	36
	305

B.—In the Summer term of 1866 the whole number of students and scholars was 893, of whom 149 were in the Mathematical and 244 in the Technical division. In detail there are—

	In the Merchants' Cl.	Cl. I.	Cl. II.	Archit. Sch.	Engin. Sch.	Machinery Sch.	Chem. Sch.	Total.
Inhabitants	9	64	50	60	49	28	39	299
Strangers	10	9	7	16	16	13	23	94
	19	73	57	76	65	41	62*	393

Of these 94 strangers there were from—

Austria, 17; Bavaria, 13; Switzerland, 9; Prussia, 8; Grand Duchy of Hessen, Russia, each 7; Baden, 6; England, 5; Saxe-Meiningen, Waldeck, North America, France, Java, each 2; Frankfort, Oldenburg, Saxe Weimar, Saxe Coburg, Hamburg, Schleswig Holstein, Belgium, Italy, Sweden, Turkey, Palestine, Brazil, each 1.

III. *Examinations.*—(Technical maturity examinations):

Announced, 53; admitted, 52; appeared, 51 } 42 from the Mathematical and 9 from the Technical division.  
 Passed, 30 } 29 from the Mathematical and 1 from the Technical division.

IV. *Prizes:*

A.—In the Mathematical divisions for peculiarly satisfactory performances in the technical maturity examinations, 1 prize.

B.—In the Technical division.

	Arch. Sch.	Engin. Sch.	Mach. Sch.	Chem. Sch.	Total.
Prize works come in	4	2	1	1	8
Prizes awarded	2	1	...	1	4

V.—*Collections, Apparatus, and Institutions of the Establishment, 24.*

VI.—*Economy of the Establishment:*

In the year 1865-66 the income was—

A.—The proper sources of income of the Institution for fees, laboratory, and substitute fees	18,500 fl. =	£1,541	13	4
B.—Addition from the State	57,500 fl. =	4,791	13	4
Total	76,000 fl. =	£6,333	0	8

\* Remark.—Of the 62 students in the Chemical school, 35 were occupied in the chemical laboratory.

2. COLLEGE FOR THE BUILDING TRADES IN STUTTGARDT.

This school numbered in 1865-66, with five classes in eleven divisions,—

I. *Teachers:*

18 head-masters, 6 assistant-masters, and 2 ushers,—together 26.

II.—*Pupils:*

A.—In the Winter term 1865-66, 587.

Among these were—

1. According to position: 578 ordinary, and 9 extraordinary.

2. According to home: 540 inhabitants, and 47 strangers.

Of the 540 inhabitants, there were 76 from Stuttgart, 172 from the Department of the Neckar, 87 from the District of the Black Forest, 110 from the Danube district, 95 from the Taxt district.

Of the 47 strangers, 18 were from Switzerland; Baden, 15; Prussia, 4; Austria, 3; Bavaria, 3; Nassau, Thuringia, Hamburg, Lichtenstein, each 1.

3. According to their calling: 475 actual builders (among whom 333 masons and stone masons, and 142 carpenters), 61 geometrical, and 51 of other trades (plasterers and stucco-workers, decorators, millers, farmers, beer brewers, &c.)

4. According to the proficiency in trade 63 overseers, drawers, polishers; 315 assistants, and 209 apprentices.

5. According to their preparatory education: From national schools, 267; middle schools, 18; real schools and school secretaries, 222; upper real schools, 42; Latin schools and gymnasiums, 26; technical schools and other higher institutions, 12.

6. According to age: Between 14 and 17 years, 215; between 17 and 25 years, 350; between 25 and 30, 14; over 30, 8.

Lowest age for admission, 14½ years; highest, 37½ years:—Average, 18½ years.

Of the 587 scholars, the school has been visited by—

	For the 1st time.	2nd time.	3rd time.	4th time.	5th time.	6th time.	7th time.	8th time.	9th time.	10th time.
Builders . . .	168	107	102	74	20	3	...	...	...	1
Geometricians	31	20	5	2	2	1	...	...	...	...
Other trades .	33	6	9	...	3	...	...	...	...	...
	<u>232</u>	<u>133</u>	<u>116</u>	<u>76</u>	<u>25</u>	<u>4</u>	...	...	...	<u>1</u>

*Attendance at the Individual Classes.*

I. Class with 2 divisions .....	76 pupils
II. " 3 " .....	220 "
III. " 3 " .....	137 "
IV. " 2 " .....	112 "
V. " 1 " .....	42 "
5 classes with 11 divisions.	Total 587 "

B.—Summer course, 1866, 115 pupils, among whom there were—

67 ordinary, and 48 extraordinary pupils.

109 inhabitants (among whom were 27 from Stuttgart), and 6 strangers (Baden, 4; Prussia, 1; Hungary, 1.)

37 builders (56 masons and stonemasons, and 31 carpenters), 6 geometricians, and 22 other trades (mechanics, locksmiths, millers, lithographers, modellers, &c.)

5 overseers, drawers and polishers, 61 assistants, and 49 apprentices.

54 from national schools, 45 from real schools, 5 from upper real schools, 10 from Latin schools and gymnasiums, 1 from the Polytechnical school.

57 of from 14 to 17 years, 54 from 18 to 25 years, 3 from 26 to 30 years, 1 over 30 years. Lowest age, 14 years; highest, 37:—Average, 18½ years.

Of the 115 pupils, the school has been visited by—

	For the 1st time.	2nd time.	3rd time.	4th time.	5th time.	11th time.
Builders . . .	11	39	27	7	2	1
Geometricians	4	2	...	...	...	...
Other workmen	17	3	...	2	...	...
	<u>32</u>	<u>44</u>	<u>27</u>	<u>9</u>	<u>2</u>	<u>1</u>



*Attendance at the Individual Classes.*

I. Class . . . . .	13 pupils.
H. " . . . .	29 "
III. " . . . .	72 "

3 classes with . . . . . 114 "

C.—Both courses together, 701 pupils.

## 3. HIGHER TRADE SCHOOLS.

In the year 1865-66 there were in Wurtemberg such schools in 108 places (89 towns and 19 villages), with a total population of 444,568 souls.

The 108 schools are divided, according to their interior arrangements, into the following groups:

1. Finishing schools, with public rooms for drawing, in which there are Sunday and evening classes for trades (Esslingen, Ludwigsburg, Gmund, Hall, Ravensburg, Caln, Biberach, Rottenburg, Ellwangen, Ehingen, Geisslingen) . . . . .	4
2. Finishing schools, with public rooms for drawing, in which there are Sunday and evening classes for trades and merchants (Stuttgardt, Ulm, Heilbronn, and Neutlingen) . . . . .	11
3. Finishing trade schools, with Sunday and evening classes, without drawing rooms (67 towns and 14 villages) . . . . .	81
4. Finishing trade schools with evening classes, but no Sunday classes (3 towns and 1 village) . . . . .	4
5. Trade schools with Sunday teaching, but no week-day classes (2 towns,) . . . . .	2
6. Pure drawing schools with no further instruction (2 towns and 4 villages) . . . . .	6
	108

The attendance of pupils, which in 1864-65, in 101 finishing schools, was 8100, rose in 1865-66, with the same number of schools, to 8264, among whom 6453 were under, and 1811 over seventeen years old.

The number of teachers was 425 (against 401 before 1864-65), so that on an average there is one master to every 19-20 pupils.

The entire sum paid by the State amounts to 21,243 fl. 21 kr. (=£1770 5s. 1d.), or 2 fl. 34 kr. (2s. 7d.) per head.

The subjects which most pupils attended were—

Arithmetic	with	4520 pupils.
Free-hand drawing	"	4209 "
Mother tongue	"	4068 "
Trade drawing	"	2419 "
General drawing	"	1892 "
Book-keeping	"	1202 "
Plane geometry	"	1105 "

The schools most visited were—

	Teachers.	Pupils.		Teachers.	Pupils.
Stuttgardt . . . . .	with 61	1285	Kirchheim . . . . .	with 3	193
Ulm . . . . .	" 21	657	Geisslingen . . . . .	" 6	145
Ludwigsburg . . . . .	" 9	246	Ravensburg . . . . .	" 7	142
Heilbronn . . . . .	" 11	210	Gmund . . . . .	" 6	130
Neutlingen . . . . .	" 17	209	Rottenburg . . . . .	" 5	124
Biberach . . . . .	" 8	201	Caln . . . . .	" 6	116
Freudenstadt . . . . .	" 6	201	Goppingen . . . . .	" 6	112
Esslingen . . . . .	" 12	196	Metzingen . . . . .	" 3	105

The trade schools in Stuttgardt had—

One evening finishing school, with 19 masters and 375 scholars.		
One Sunday trade school	" 22	" 673
One merchants' finishing school	" 15	" 149
One females' finishing school	" 5	" 88
	61	1285

## ORGANIZATION OF NATIONAL EDUCATION.

Having now considered the general nature, number, attendance, and cost of a national system of schools in an educated country, we should very inadequately appreciate the value of such a system, unless we take the trouble of examining the nature of each of these classes of institutions, and the extent and character of the teaching organization which is provided.

The first remarkable circumstance is the number and high qualification of the teachers.

The second is, the thoroughness and extent of the courses of education.

The third is, the extent of the material organization for teaching, the largeness and beauty of the buildings, the nature of the museums and libraries which are attached to them, and the provisions for practical instruction in the nature of workshops, farms, hospitals, and museums.

Finally, the nature, character, business, and number of the students who attend these institutions, and their regularity and proficiency, may be to some extent gathered from the following Tables:—

## TABLES OF ORGANIZATION.

1. TECHNICAL UNIVERSITY; 2. COLLEGE FOR THE BUILDING TRADES; 3. COLLEGES OF AGRICULTURE AND FORESTRY; 4. VETERINARY COLLEGE; 5. SCHOOL OF ART WORKMEN; 6. HIGH SCHOOLS, OR ACADEMIES AND SCIENCE SCHOOLS; 7. ELEMENTARY GOVERNMENT SCHOOLS; 8. INDUSTRIAL SCHOOLS.

*Organization of the National System of Technical Education.*

## 1. TECHNICAL UNIVERSITY

The object of this school is to educate future *technics*.

The instruction given is five courses of one year each.

It is divided into two branches—the Mathematical and the Technical. The former consists of two, and the latter of three classes.

The Technical section is subdivided into four schools:—

1. For architecture.
2. For engineering.
3. For machinery.
4. For technical chemistry, with the subdivisions—
  - (a) Chemical manufactures
  - (b) Mines.
  - (c) Pharmacy.

(There is also a parallel class devoted to preparing pupils for being merchants.)

*Conditions of entrance:—*

1. A certain age.
  - For the *mathematical* division, the pupil must have attained his 16th year.
  - For the *merchants'* class, the pupil must have attained his 16th year.
  - For the *technical* division, the pupil must have finished his 18th year.
2. In addition, they must have certificates of position, conduct, &c.
3. The necessary preparatory knowledge.
4. And, where under age, the written permission of parents and guardians to enter the school.

They must pass an examination in which, for the *mathematical* division, the following knowledge is required—

- (a) Algebra up to equations of the 2d degree, inclusive. Exercises in the use of logarithms.
- (b) Geometry and stereometry.
- (c) Principal heads of plane trigonometry.



- (d) Correspondence in the French language, with a proper translation of a not difficult theme from German into French.
- (e) Practice in German style—an exercise of a theme on a given subject.
- (f) Knowledge of the principal periods and events in history.
- (g) Knowledge of the elements of mathematical, physical, and political geography.
- (h) Practice in geometrical and free-hand drawing.

For entrance into the *mercantile* division, the examination will include the following subjects:—

- (a) Practice in reckoning figures, inclusive of decimal fractions, with regard to mercantile requirements.
- (b) Familiarity with the French language, translation of a not difficult theme from German into French.
- (c) Good German style—a theme on a given subject.
- (d) Knowledge of the principal periods and events in history.
- (e) Knowledge of mathematical, physical, and political geography.

In the *technical division* the pupils produce a certificate of competency from the schools or masters they have visited.

The fees are—

A.—In the Mathematical division—  
 For ordinary pupils 50 fl. (4l. 3s. 4d.) a year.  
 For extraordinary pupils 1 fl. 30 kr. (2s. 8d.) the half-year, for each lesson a week.

B.—In the Technical division—  
 For ordinary pupils 60 fl. (5l.) a year.  
 For extraordinary pupils 1 fl. 45 kr. (2s. 11d.) the half-year, for each lesson a week.  
 Besides this, the pupils pay 42 kr. (1s. 2d.) per half year for servants; and if they attend the chemical experiments, 5 fl. (8s. 4d.) for materials. In addition to this, the entrance fee is 5 fl. (8s. 4d.)

There are the following means attached to the division of practical instruction:—

The chemical laboratory.		The arrangements for modelling in plaster.
The physical laboratory.		The mechanical workshops.
The arrangements for mineralogical studies.		The wood pattern making.
The arrangements for constructive experiments.		The botanical garden.

STAFF.—*Heads and Professors.*

*Director of the entire Institution.*—Prof. Dr. Zech.  
*Head of the Mathematical division.*—Rector Dr. v. Gugler.

*Heads of the Trade Schools—4.*

- |                              |  |                            |
|------------------------------|--|----------------------------|
| 1. Architectural school.     |  | 3. Of the machinery school |
| 2. Of the engineers' school. |  | 4. Of the chemical school. |

There are 24 head masters, including those named above: 9 under masters, 11 assistants, 7 private tutors.

Older persons not wishing to attend regularly as students, are admitted as "listeners." They pay 3 fl. the half-year, for one lesson a week; for two lessons a week, 6 fl. (10s.); for each further lesson, 2 fl. more per half-year.

CLASSES.—A.—MATHEMATICAL DIVISION.

*First Class.*

Plane and spherical trigonometry. In winter, 5 hrs.; repetition, 2 hrs.	}	Recapitulation of plane trigonometry, general explanation of functions of the foundation of the right-angle co-ordinate system, polygonometry, spherical trigonometry.	
Lower analysis, 4 hrs.; repetition, 2 hrs.		Algebra, logarithms, geometrical progression, permutation, combination, interpolation, &c.	
Analytical plane geometry. In summer, 6 hrs.; repetition, 3 hrs.		Co-ordinate system, transformation of co-ordinates, lines of the 1st and 2d order, exercises.	
Descriptive geometry, I. In summer, 6 hrs.; repetition, 2 hrs.		Exercises on lines and planes, polygons, broken lines, planes and broken surfaces.	
Plan and terrain drawing. 2 hours.		Copying plans in original and reduced size, elevation, maps, with horizontals, &c.	
Free-hand drawing. In 2 divisions; each 4 hours.		Figures from casts in outline.	
German language. In 2 divisions; each 2 hours.		Grammar, style, poetry, explanation of individual poems and classical works.	
French language. In 2 divisions; each 4 hours.			
English language. In 2 divisions; each 2 hours.			
Geography. In 2 divisions; each 2 hours.		}	Mathematics and physical geography, the principal countries, with regard to their history.
History. In 2 divisions; each 2 hours.			General history, ancient history.
Religion, { Evangelical, } { Catholic. } 1 hour.			

*Second Class.*

Higher analysis, I. 4 hours; repetition, 2 hours.	}	Differential calculus, fundamental functions, maxima and minima, &c., &c.
Analytical geometry of space. In winter, 4 hrs.; repetition, 2 hrs.		Plane and right lines, surfaces of the second order, turning and right planes.
Descriptive geometry. 4 hours.	}	Sections of curved surfaces, &c., application of shadows and perspective.
Practical geometry. In winter, 4 hours.		Encyclopædical review of plane geognosy, right-angle co-ordinates, and geometrical levelling.
General mechanics. 6 hours.	}	Elements of mechanics, solid & floating bodies.
General physics. In winter, 4 hours.		}
Drawing of buildings. In winter, 4 hrs.; in summer, 8 hrs.		
Free-hand drawing. In winter, 4 hrs.; in summer, 2 hrs.		
Review of German literature. 1 hour.		
French language. In 2 divisions; each 2 hours.		
English language. In 2 divisions; each 2 hours.		
History. 2 hours.		Universal history, middle ages and modern.

*Mercantile Class.*

Counting house. 6 hours.	}	Introduction to commerce, various kinds of trades, various manners of bookkeeping, conduct of an imaginary business, various kinds of "conto" currencies.
Mercantile arithmetic. 4 hours.		Calculation of values; interest, compound and simple; exchange, &c., &c.
Mercantile geography. 3 hours.	}	Dependence of productiveness on longitude and latitude, on elevation over the sea, on mountains and directions of rivers. Europe and the Colonies. Lands, with regard to merchandise and commerce.
German language, 2 hours.		
French language, 4 hours.		
English language, 4 hours.		
Italian language, 5 hours.		
French correspondence, 2 hours.		
English and Italian correspondence, 2 hours.		
Introduction to the laws of exchange, 1 hour.		
Free-hand drawing, 2 hours.		
Religion, 1 hour.		In common with the mathematical class
Gymnastics for the whole mathematical division, 2 hours a week.		

## B.—TECHNICAL DIVISION.

1. *Mathematics and Mechanics.*

Trigonometry and lower analysis, 4 hours.		
Higher analysis, I. In winter, 4 hours.		
Higher analysis, II., 2 hours	}	Differential comparisons, decided integrals, &c.
Analytical geometry. In winter, 4 hours.		
Newer geometry. In summer.		
Descriptive geometry, 4 hours	}	Applied to shadow-drawing and perspective.
Practical geometry. Method of least squares. In winter, 3 hours.		
Analytical mechanics, 4 hours.		
Engineers' mechanics		

2. *Natural History.*

Zoology. In winter, 4 hours.	}	Universal systematic zoology, with regard to comparative anatomy, pharmacy, and agriculture.
Anthropology. In winter, 2 hours.		Knowledge of the construction of the human body.
Botany. In summer, 4 hours.	}	Universal and special botany.
Medicinal pharmaceutical botany. In summer, 3 hours.		Natural families of plants.
Knowledge of plants. In winter, 4 hours	}	With regard to their medicinal qualities.



Anatomy and physiology of plants.

In winter, 3 hours.

Use of plants.

In summer, one afternoon.

Use of the microscope, one afternoon.

Mineralogy.

In winter, 4 hours; repetition, 2 hrs.

Crystallography.

In winter, 2 hours lecture.

Geognosy.

In summer, 4 hours, with exercises.

Petrology, 4 hours.

Physical practice, two afternoons.

General and technical chemistry, 6 hrs.

Chemical practice, 9 to 12.

Chemistry for builders.

In winter, 4 hrs.; in summer, 2 hrs.

Analytical chemistry.

In winter, 2 hrs.; in summer, 3 hrs.

The modern theories of chemistry.

In winter, 2 hours.

{ The chemical and physical properties of crystals.

{ The laboratory is open from 9 in the morning till 5 in the afternoon.

{ The lecture is for those who are not going into chemistry as a profession, but only in so far as it concerns their individual professions.

{ Qualitative and quantitative analysis.

### 3. Technology.

Chemical technology.

In winter, 3 hrs.; in summer, 4 hrs.

Chemical technology in practice, 9 hrs., private.

Mechanical technology, 4 hours.

Heating.

In summer, 4 hours.

{ Burning materials, lighting and fire, starch and sugar, vinegar, &c.

{ The metals most necessary to technics, their working; wood; visits to working establishments.

{ Preparation, burning materials, transmission of heat, hearths, chimneys, ventilation.

### 4. Machinery.

Preparatory course, 3 hours.

{ For those who have worked in the shops, but do not possess the necessary knowledge to attend the other classes. Repetition of lower mathematics, elements of analytical geometry, differential and integral calculus, mechanics.

Construction of machinery, I.

(a) Lecture, 5 hours.

(b) Exercises in construction, 6 hrs.

Construction of machinery, II.

(a) Lecture, combined with practice, 7 hours.

(b) Construction, 6 hours.

Construction of machinery, III.

Lecture, 4 hours.

Construction, 6 hours.

Machinery for engineers: lecture, 2 hrs.

Popular machinery, 4 hours.

Statistics of iron roof and bridge construction, 1 hour, private.

{ Adhesiveness of materials, elements of machinery, water-wheels.

{ Stationary steam engines and steam kettles, locomotives and marine engines.

{ Designs for entire works (workshops), pumps and all the apparatus for works with steam and water power, with heating and lighting, disp. of machines.

{ Application of steam and water power.

{ Machinery for raising heavy bodies, machines for working by water and air, locomotives and railways.

{ Calculations of cost.

### 5. Engineering.

Practical geometry.

In winter, 2 hours lecture.

Practical geometry.

In summer, one afternoon for each division.

Engineers' mechanics, 5 hours lecture; 4-6 hours practice.

Winter course.

Summer course.

{ Instru. for measuring angles, plane triangulating, trigonometric and barometric levelling.

{ Practice at measuring and distance tables, and the theodolite, trigonometric elevations. Excursions of fourteen days.

{ Elasticity and strength of building materials, beams, ceilings, buttresses.

{ Statics and dynamics of liquid and gaseous bodies, with regard to the practical work of an engineer.

Bridge building, I. In summer, 4 hours lecture; 4 hours practice.	} Stone constructions, especially stone bridges.
Bridge building, II. 6 hours lecture; 6 hours practice.	
Bridge building, III. In winter, 6 hours practice.	
Ponts et chaussees, and railway construction. In winter, 8 hours lecture; 4-6 hours practice. In summer, 4 hours lecture; 12 hours practice.	} Mills, fountains, &c., railways, stations, bridges, carriages, barriers, signals, telegraph stations, and telegraphs.
Tracing and ("earth calculation"?) In summer, 2 hours.	

6. *Architecture.*

Building materials. In summer, 4 hours.	} Physical properties of mineral and vegetable building materials, &c., &c..
Construction of buildings, I. 4 hours lecture; 6 hours practice.	
Construction of buildings, II. 2 hours lecture; 4 hours practice.	} Stone and wood buildings.
Higher architecture, 2 hours lecture; 4 hours practice.	
Calculation of building costs. In summer, 2 hours.	} Iron construction, and put-together buildings.
History of architecture (I. and II.), 2 hours each.	
Practice to the above (I. and II.), 2 hrs.	} Public and private buildings, designs and plans, &c.
Comparative building forms. In summer, 2 hours.	
Designs (I. and II.) Two successive courses, one with 4 hrs., the higher with 8 hrs.	} Ancient, middle age, and renaissance.
Artistic perspective (I. and II.) Two successive courses, each with 2 hours.	
	} Graphic drawings and details of each period, with regard also to materials.
	} As a preparation to designing.
	} A subject is given to the student to finish in one day, which is judged by all the architectural teachers, and discussed with the pupils.

*Drawing and Modelling.*

Free-hand drawing. In winter, 8 hrs.; in summer, 6 hrs. with excursion.	} Figure drawing, landscape drawing, in outline and shadows.
Ornamental drawing and modelling. In three divisions, each with 6-8 hrs.	
Special drawing classes for engineers, mechanics and architects.	} Drawing of ornaments from clay and plaster, designs for ornaments, casts done by the students in clay or plaster from their own or others' designs.

*General Subjects.*

History of the 18th and 19th centuries, . . . . .	2 hours.
History of the last twelve years . . . . .	1 hour.
History of art in the middle ages . . . . . In winter	4 hours.
Durer and Holbein . . . . . In summer	3 hours.
Raphael and Michael Angelo . . . . . In winter	2 hours.
Explanation of the works of art in the State collection . . . . . up to	6 hours.
Mythology of the Greeks, Romans, and Germans . . . . . In winter	2 hours, private.
History of modern German poetry . . . . . In winter	2-3 hours.
Principles of esthetics (or knowledge of the beautiful) . . . . . In winter	3 hours.
Agriculture and husbandry . . . . .	3 hours.
Trades:— . . . . .	3 hours.
Borrowing money for founding a factory—by advances, shares, companies, &c. Interest on capital, premiums, dividends. Profit and loss, &c., &c.	
Laws of property . . . . .	3 hours.
Grammar of the middle ages . . . . .	3 hours, private.
Modern German grammar . . . . .	3 hours, "
Poetry . . . . .	2 hours, "
French language and literature . . . . .	4 hours.
English language and literature . . . . .	3 hours.
Shakespeare's dramas . . . . .	1 hour, private.
Italian—with the mercantile class . . . . .	5 hours.
Gymnastics . . . . .	2 hours.
Fencing . . . . .	private.



*Workshops.*

Modelling of machinery and engineering objects. Both workshops are open all day.

## PLAN OF STUDY.

The plan of study for the mathematical division is given above.

In the technical division the choice of lectures is left free to the students. A plan of study is here given as a sort of guide to the subjects which are most necessary for each profession, the time which the student has to devote to it, and the proficiency or position he desires to obtain in it.

A.—*Architectural School.*

- First year.*—Chemistry for technic builders; mineralogy and geognosy; practical geometry, with practice; engineering mechanics, with practice; building construction, I., with practice; history of art; free-hand and ornamental drawing.
- Second year.*—Building construction, II., with practice; building construction, I., with practice; designs, I.; perspective, I.; free-hand and ornamental drawing.
- Third year.*—High architecture, with practice; history of building, II., with practice; comparative building forms; designs, II.; perspective, II.; free-hand and ornamental drawing.

Pupils who wish to go further, and become higher architects, decorators, &c., have a special fourth year's course laid out for them by their master, which will be regulated according to their special talents, the advance they have made, &c.

B.—*Engineers' School.*

- First year.*—Chemistry for technic builders; mineralogy and geognosy; practical geometry; engineering mechanics; construction of bridges, with practice; building construction, I., with practice.
- Second year.*—Bridges, II., with practice; building construction, II., with practice; construction of machinery for engineers; practice in the construction of machinery; building history, I.; free-hand drawing.
- Third year.*—Bridge building, III., ponts et chaussees, railways, with practice; surveying and calculations of earth works; history of building, II., with practice.

C.—*Machinery School.*

- First year.*—Chemistry for technical builders; engineering mechanics; construction of machinery, with practice; free hand drawing; mechanical workshops.
- Second year.*—Construction of machinery, II., with practice; mechanical and chemical technology; bridge building, II.; heat.
- Third year.*—Construction of machinery, III., with practice; ponts et chaussees; building, II.; agriculture (political economy).

D.—*Chemical School.*

1. For technical chemists and teachers of chemistry:—
 

*First year.*—Physics for chemists; general and technical chemistry; analytical chemistry; mineralogy; construction of buildings.

*Second year.*—Analytical chemistry; chemical practice; chemical technology; practical physics; practical mineralogy; popular mechanics.

*Third year.*—Chemical practice; chemical technology; laws of property.
2. For miners:—
 

*First year.*—Physics for chemists; universal and technical chemistry; mineralogy; machinery, I., with practice; construction of buildings, I., with practice.

*Second year.*—Analytical chemistry; chemical, physical, and mineralogical practice; machinery, II., with practice; heat.

*Third year.*—Chemical practice; chemical technology; machinery, III., with practice; farming and husbandry (political economy); laws of right and possession.
3. For apothecaries. (It is a two years' course, but if the pupil has made sufficient progress, he can pass in one or one and a half years):—
 

*First year.*—Physics for chemists; universal and technical chemistry; knowledge of medicine; zoology; general botany; medicinal properties of plants; mineralogy; chemical and microscopic practice.

*Second year.*—Analytical chemistry; chemical and mineralogical practice; pharmaceutical botany; the anatomy and physiology of plants; microscopic pharmaceutical practice.

## II.—COLLEGE FOR THE BUILDING TRADES.

- I. The object of this school is to educate technically for the following trades:—
  1. *Future master builders* (masons, stonemasons and carpenters).
  2. *Lower technical builders* (upper building masters, public building and foundation builders, and constructors of reservoirs).

3. *Lower water-works and mill builders.*

4. *Geometers of the first and second class.*

Besides these, individual classes can be attended by—

Plasterers, tilers, roofers,  
Lower mechanics, glaziers, turners,  
Decorators, ornamental sculptors, modellers,  
Engravers, gold and silver workers,  
Gardeners and husbandmen, &c.

The classes go on the whole year round, and the course consists of five half-years, and these can be taken either all in winter, all in summer half-years, or partly in winter and partly in summer.

The pupils are of two kinds—*ordinary* and *extraordinary*. The first are such as devote their whole time to the school; and the second such as attend other schools, studios, &c., in addition.

## II. *Conditions of Admission:—*

In order to be admitted into school the pupils must—

- |   |  |
|---|--|
| 1. Have attained a certain age.   | { (a) For the 1st class at least 14 years.<br>(b) For the 2d, 3d, 4th and 5th classes respectively, 15, 16, 17 and 18 years, to which exceptions are sometimes made. |
| 2. A certificate of good conduct.   |  |
| 3. The certificate of the necessary preparatory knowledge (for which they must pass an entrance examination). |  |
| 4. In cases of minority a certificate of the permission of parents or guardians to enter the institution.     |  |

## III. *Divisions:—*

The school is subdivided into three departments—

1. *A building school.*
2. *A geometry school.*
3. *A school for drainage and waterworks.*

## IV. STAFF.—Head: Oberbaumeister v. Egle; Assistant Head: Professor Haberle.

Professors and head masters:

For the building trades	. . . . .	. 8 professors.
“ practical geometry and pure mathematics	. . . . .	. 2 “
“ mathematics and natural history	. . . . .	. 4 “
“ free-hand and ornamental drawing	. . . . .	. 2 “
“ general education	. . . . .	. 2 “
Other teachers:—For religion, for ponts et chaussees, for lan- guages, for caligraphy, &c., &c., &c.	. . . . .	. 6 masters.
Assistant teachers	. . . . .	. 3 “

## PLAN OF INSTRUCTION.

### *First Class.*—With two parallel divisions.

Destined for such pupils as have only attended the national schools, or who, having been at a higher school, were yet not found competent to enter the second class.

German language	. . . . .	. 8 hours a week.	
French	. . . . .	. 4 “	
History and geography	. . . . .	. 4 “	
Caligraphy	. . . . .	. 6 “	
Arithmetic	. . . . .	. 6 “	(Vulgar and decimal fractions, compound and simple interest, &c.)
Elementary geometry	. . . . .	. 6 “	(Plane geometry.)
Free-hand drawing	. . . . .	. 6 “	(Plain lines, simple leaf and contour lines.)
Geometrical drawing	. . . . .	. 6 “	(Geometrical construction and decoration.)

### *Second Class.*—Three parallel divisions.

German language	. . . . .	. 6 hours a week.	(Continuation of the former class.)
French	. . . . .	. 2 “	
Caligraphy	. . . . .	. 3 “	(Plan drawing.)
Geometry and stereo- metry	. . . . .	. 8 “	(Continuation and completion of plane geometry, geometry of space and cubic contents.)
Algebra	. . . . .	. 8 “	(Powers, roots, logarithms, comparisons of 1st and 2d grade.)
Plan drawing	. . . . .	. 8 “	
Ornamental drawing	. . . . .	. 6 “	(Simple drawing in color and from plaster.)

### *Third Class.*—Three parallel divisions.

Natural history	. . . . .	. 6 hours a week	(Weight and motion of water and bodies heat, &c.)
Representative geometry	. . . . .	. 8 “	



Trigonometry . . .	2	hours a week.	
Practical geometry	6	"	
Plan drawing . . .	6	"	(Complicated architectural details—windows, portals, &c.)
Ornamental drawing	6	"	(Chalk and pencil drawings in outline and shaded from plaster models.)
Building . . .	5	"	(Form and decorative stone work, cornices, windows, entrances, &c.)
Construction . . .	5	"	(Building in stone, walls in brick and stone, brick and tile building.)

*Fourth Class.—Two parallel divisions.*

Mechanics . . .	3	hours a week	(Continuous lessons on stability applicable to beams and rafters, stability and machinery with regard to the requirements of technical builders.)
Applied representative geometry	6	"	(Applied to stone carving, shadows, &c.)
Plan drawing . . .	6	"	(Drawing in outline of whole facades, and designs in renaissance style.)
Ornamental drawing	4	"	(Continuation of drawings in the third class.)
Knowledge of building materials . . .	2	"	(Properties of various building materials, and their adaptation for different purposes.)
Building . . .	5	"	(Decoration of buildings and dwelling houses, size and disposition of space, &c., &c.)
Construction of buildings . . .	5	"	(Wooden posts, scaffoldings, beams, joints, and suspensions, locks and roofs, &c.)
Builders . . .	4	"	(Instructions for master builders, tools and instruments, general rules, &c.)
Heating apparatus	6	"	(Chemical constitution and heating power of burning materials, temperature of burning, length of chimneys, drawing power, calculation of sizes and construction, roasting and fire-room grates, &c., baking arrangements.)
Building style . . .	4	"	(Sketch of architectural history,—Greek and Roman styles, sketches.)

*Fifth Class.—Division A.*

Ornamental modelling,	4	hours a week	(Modelling in plaster and clay, generally after drawings made by the pupils; casting.)
Building construction,	4	"	(More complex roofs, suspended, &c., with iron applications; carpentry and glazing.)
Designs of buildings . . .	9	"	(Designs for simple country and town houses, parsonages, &c. &c., in sections, ground plans and elevations.)
Building styles . . .	4	"	(Old Saxon style, Roman and Gothic renaissance, sketches and designs in each style.)
Ponts et chaussees . . .	4	"	(Roads, wooden and iron bridges.)
Calculations of building costs . . .	4	"	(Estimates for materials and workmen, calculation for contracts.)
Agricultural buildings,	3	"	(Arrangement of space, organization of store-rooms, barns, out-houses, stables, &c.)
Mathematical practice,	4	"	(Repetition of elementary mathematics, with exercises.)

## Division B.

Designs for buildings,	10	hours a week	(Designs for large schoolhouses, business and dwelling houses on a limited space, hospitals, &c.)
Designs for parts of buildings . . .	6	"	(Roofs, staircases, beams, and ceilings, to be drawn in large and minute detail.)
Repetition of mathematics, physics, and mechanics . . .	6	"	
Exercises on building materials . . .	2	"	
Book-keeping . . .	1	"	

## GEOMETRICAL SCHOOL (for Advanced Pupils).

Geometric'l construction . . .	2	hours weekly	(Solution of problems by construction.)
Algebra applied to geometry and stereometry . . .	6	"	(Solution of geometrical and stereometrical problems by calculation.)
German exercises . . .	2	"	

*Special Classes for Geometers.*

Representative geometry	} 8 hours weekly (As in the third class of the building school.)	
Natural history (physics)		} 6 " (As in the third class of the building school.)
Trigonometry		
Plan drawing	4 " " (Building, measuring, &c.)	
Popular building and plan drawing	} 8 " (Building, measuring, &c.)	
Practical geometry—		
From the 6th Nov. to 15th March, 6 hours weekly; from the 16th March to 1st May, 28 hours weekly; Mathematical practice, 14 hours weekly.		

OTHER INSTRUCTION.

Machine drawing . 8 hours weekly (Curves and angular constructions, drawings of parts of machines.)

Entrance Fees.

For participation in *one* class during the whole course:—

- (a) In the building school, 12 florins = 1*l.*
- (b) In the building school (on account of greater length of course), 16 florins = 1*l.* 6*s.* 8*d.*

In cases where a pupil is declared by the community to be utterly without means, and can show a certificate of industry and good behavior, he is admitted without payment, or on part payment only of the fees.

III.—COLLEGE OF AGRICULTURE AND FORESTRY.

I. THE INSTITUTION IN HOHENHEIM.

A.—*Agriculture and Forestry Academy.*

This numbered in the year 1865–66:—

I. *Teachers' places:*—

10 regular professors (including the Director); 6 under-masters; 2 ushers; and 3 assistants = 21.

II.—*Students:*—

A.—In the Winter term 1865–66, 123; of whom 61 were of the country, and 62 strangers. These studied:

	Agriculture.	Forestry.	Total.
Inhabitants . . .	24	37	61
Strangers . . .	60	2	62
	84	39	123

Of the 62 strangers, 41 were from other German places; namely, Austria, 15; Prussia, 9; Bavaria, 5; Holstein, 4; Baden and Hamburg, each 3; Hessen. Homburg, and Lubec, each 1. 21 came from other countries; as, Russia, 11; Switzerland, 3; England and Norway, each 2; Portugal and Brazil, each 1.

B.—In the Summer term 1866, 108: of whom 56 were inhabitants, and 52 strangers. These studied:

	Agriculture.	Forestry.	Total.
Inhabitants . . .	18	38	56
Strangers . . .	50	2	52
	68	40	108

Of the 52 strangers, 33 were Germans; namely, Austria sent 10; Prussia, Bavaria, and Baden, each 4; Holstein, 3; Hamburg, 2; Frankfort, Lubec, Hanover, Saxony, Mecklenburg, and Kurhessen, each 1. And from other countries came 19; Russia sent 11; Switzerland, 4; England, Belgium, Portugal, and Brazil, each 1.

III.—*Students' Excursions* were made (besides smaller ones) during the Summer term of 1866, to:

- One Agricultural, to the Rechbergan seats, the Alb, and several estates in Upper Swabia.
- One Forestry, in the hunting district Dankoltswicler, the Forest of Ellwangen.

IV.—*Distinction of Students:*—

	Husbandmen.	Foresters.	Total.
By prizes . . .	1 (stranger)	3 (inhab.)	4
By public commendation .	1 (stranger)	1 (inhab.)	2
	2 (strangers)	4 (inhab.)	6

V.—*Collections, Apparatus, and Institutions of the Academy*—together 18.



B.—*The Farming School.*

On the 1st of October, the number of scholars was 25.

At the close of the school year, 9 left the establishment, of whom 4 went to assist their father in his farms, 3 became stewards in the country, and 2 stewards of projects abroad.

The head-master taught field-measuring and botanizing on Sundays and holidays, not counting 464 hours, of which 118 were devoted to agriculture; farming, 81; geometry and stereometry, 52; German language, exercises, &c., 43; mental arithmetic, 39; accounts, 22; physics, 24; and drawing, 45.

The medical professor of the academy gave 37 hours lessons of instruction in veterinary surgery.

Excursions of four days were made, with the older classes, to Baden and Strasburg, besides which there were several minor excursions in the neighborhood.

C.—*The Gardening School.*

Five pupils were entered on the 15th October, 1865, of whom, at the end of one school year, 1 remained for further instruction in Hohenheim, 1 was dismissed on account of illness, 1 emigrated to America, and 2 obtained situations as gardeners.

The instruction given by the two gardeners of the institution occupied 280 hours, of which 45 were devoted to botany, 10 to fruit trees, fruits, and the knowledge of special plants, 16 to repetitions, and 86 to drawing. The remaining lessons they share with the pupils of the schools for farming.

D.—*Special Agricultural Courses.*

1. The courses for meadow-land, and draining, and marking boundaries, could not be given on account of the non-attendance of pupils.
2. Nine attended the sheep-course.
3. The fruit-tree course, in two divisions, was attended by 29 pupils. Seven from the Neckar district, 10 from the district of the Black Forest, 2 from the Taxt district, and 10 from the district of the Danube.
4. The agricultural course for national school teachers was attended by 19 teachers.

E.—*Advice on Agricultural Matters*

was asked; about malt kilns; on hop-drying kilns; and on the cultivation of lupines.

2. FARMING SCHOOLS IN ELLWANGEN, OCHSENHAUSEN, AND KIRCHBERG.

These are adapted for 12 pupils, with a three years' course—so that each establishment has 4 pupils.

Excursions were made by the pupils with the director or another master:  
5 in Ellwangen; 2 in Ochsenhausen; 3 in Kirchberg.

The State domains on which these farming schools are built, comprise:

In Ellwangen . . . . .	394 <sup>5</sup> / <sub>8</sub> miles.
In Ochsenhausen . . . . .	414 <sup>7</sup> / <sub>8</sub> miles.
In Kirchberg . . . . .	553 <sup>3</sup> / <sub>8</sub> miles.

A brewery is attached to Ellwangen, in which 1800—2000 kilderkins of beer are brewed yearly.

3. THE FINISHING FARMING SCHOOLS, AND OTHER ARRANGEMENTS, CLASSES, ETC., FOR THE SAME PURPOSE.

	Obligatory winter evening schools, with instructions in farming.	Free finishing schools for farmers.	Agricultural meetings.	Agricultural lecture meetings.	No. of Establishments together.
In the Neckar district	46	48	9	12	115
In the district of the } Black Forest . . . }	90	40	12	11	153
In the Taxt district . .	72	19	10	8	109
In the Danube district	97	17	15	17	146
In the whole country	305	124	46	48	523
The attendance at these classes was:					
In the Neckar district	1500	1000	300	350	3,150
In the district of the } Black Forest . . . }	2130	800	290	210	3,430
In the Taxt district . .	1220	350	270	180	2,020
In the Danube district	1980	480	630	350	3,440
In the whole country	6830	2630	1490	1090	12,040

So that, in 523 establishments, 12,040 persons enjoyed the privilege of instruction in agricultural matters.

The winter evening schools are the affair of the schoolmaster concerned. The instruction in the free finishing agricultural schools was principally given by the schoolmasters, and also by clergymen, veterinary surgeons, magistrates, and farmers.

In the agricultural evening meetings, the lectures were given by the schoolmasters and farmers of each district, who also superintend the reading rooms and libraries.

#### IV.—VETERINARY COLLEGE.

In the school year 1865-66, with two courses, it numbered :

I. *Masters*:—4 head-masters, 1 assistant teacher, 1 usher = 6.

Besides these regular masters, the pupils had lessons in chemistry and botany from two other masters.

II. *Pupils*:—57; among whom there were 55 regular, and 2 irregular; 45 civil, and 12 military pupils; 41 inhabitants, and 16 strangers (of whom 4 were from Schleswig-Holstein, 4 from Switzerland, 2 from Baden, 1 from Hanover, 1 from Hesse Darmstadt, 1 from Kurhesse, 1 from Oldenberg, 1 from Luxemburg, 1 from Russia.)

III. *The Examination* was attended by 30 pupils, namely, 15 inhabitants, and 5 strangers:—

Of the 15 inhabitants, 1 obtained the first class, 11 the second, 2 the third, 1 no prize.

Of the 5 strangers, 4 obtained the second class, 1 the third.

IV. *Prizes were awarded*:—In the second course, a first and a second.

In the first course, a first and two second, and besides, two "Smith prizes."

V. *Institutions*:—1. *The hospital* had to do with—

(a) On the whole, 775 horses, of whom—

522 (26 more than in 1864-65), were taken into the stables of the establishment, and 253 were treated out of the establishment.

Of the 522 horses—453 were put under doctors' care; 299 on account of interior illness; 154 on account of external illness; 69 were examined for defects.

Of those 453 which were treated, 307 were cured, 73 improved, 41 killed, 11 shot, and 21 sent away as incurable.

Besides this, there were 29 horses used for anatomical purposes, operations, dissections, &c. Whole number of horses, 804.

(b) *The cattle in the hospital* and those attended in the stables of their proprietors, numbered, in the town and its eighteen suburban villages, 820 animals.

Besides this, there were 6 cows for the supply of the pock lymph for the central vaccinating doctor. Total number of cattle, 826.

(c) *The dog hospital* had to do with 213 animals, of whom—

175 were handled medically, and 38 put under the supervision of the police.

Of the latter 38—7 were killed for biting; 24 were taken up as mad, of whom 16 were shot as regularly mad.

(d) Of other animals with which the establishment had to do, the following are the number:

23 cats; 14 sheep (7 in the institution, 7 out); 40 pigs (3 in the institution, 37 out); 16 goats. Total 93.

Entire number of domestic animals treated by the establishment—1936.

2. *In the smithy* (in the course of the year 1865-66):—

Shoes finished . . . . . 2605

Animals calked . . . . . 1009 } Among whom, 810 were of the town, 199 from outside; 1001 horses, and 8 head of cattle.

Animals shod . . . . . 4035 } Of which 1948 were new, 2087 old.

Given out to do . . . . . 602

Given out to pupils in the }  
2nd course as patterns } . . . . . 70

VI. *Collections*:—1. Exclusive of journals and papers, the library was enriched by 47 numbers. 2. The collection of anatomical and pathological works was enriched by 57 numbers.

VII. *Opinions (Judgments) given in Court*, 10.

VIII. *The Special Course for Smiths*, which was established for the central agricultural and trade places, was attended by 8 people (4 masters and 4 apprentices).

#### V.—SCHOOL OF ART-WORKMEN.

I. *Masters' Places*:—4 principal masters and 4 assistant masters—together, 8. (In the Summer term, 1866, an extra head-master was employed.)

II. *Pupils*:—In the Winter term 1865-66, 50, (1864-65 there were 59; 1866-67 there were 55). Among these 50 there were:—

(a) 44 regular; 6 irregular.

(b) Wurtembergers, 42; strangers, 8 (from Austria, 2; Saxony, 1; Baden, 1; Grand Duchy of Hessen, 1; Nassau, 1; Saxe Coburg, 1; America, 1).



(c) According to calling:—12 painters, 18 sculptors, 5 lithographers, 1 engraver, 2 wood engravers, 3 drawers, 1 decorator, 2 room decorators, 1 modeller, 1 dilettante.

Concerning the attendance at the different classes, there were:—

At the drawing and modelling after the antique . . . . .	26
At the drawing and modelling after life . . . . .	30
At the landscape drawing . . . . .	21
At the oil painting . . . . .	12
At the lessons in perspective and shading . . . . .	6
At the lessons in anatomy . . . . .	30
At the lessons in the history of art . . . . .	9

III. In the *Examination* which was held according to law in 1866, there were 5 favorable results.

IV. Ten art pupils obtained *Exhibitions*, 5 for further instruction in the art schools of Wurtemberg, 5 to enable them to continue their studies abroad. Besides this, 7 were taught free of expense.

V. Prizes were awarded to 10 pupils—5 first, and 5 second.

VI. For the *Exhibition* of students' works of art, which precede the examinations, 19 works in plaster were sent; among which there were 4 statues and a relief, all original, and a relief portrait; 19 drawings from the antique; and from nature:—

1 Portrait drawing.	2 studies of animals in oil,
15 Landscapes.	1 Colored cartoon (composition), and
26 Heads in oil.	3 Engravings on copper.

VII. 12 Works were bought or ordered of the best pupils, the total price of which was 1,972fl. (168l. 6s. 8d.); the price of the lowest being 50fl. (4l. 3s. 4d.), and the highest 580fl. (48l. 6s. 8d.)

## VI.—HIGH SCHOOLS OR ACADEMIES AND SCIENCE SCHOOLS.

### A.—High Schools or Academies.

1. On the 1st of March there were 88 public academies. These are subdivided into—4 low Evangelical seminaries; 7 land gymnasiums, of which one is in connection with a boarding-school, Catholic; 3 lyceums and one Latin school, with an upper provisional lyceum class; and 73 lower Latin schools, of which two are erected provisionally.

2. The public academies numbered, on the 1st of March, 1866, together, 225 school classes, of which 7 were provisional. Of these, there were—In the seminaries, as well as in the upper divisions of gymnasiums and lyceums (including 3 provisional classes), 33 classes. In the middle and lower divisions of the gymnasiums and lyceums (including a provisional class), 66 classes. In the 73 lower Latin schools (including 3 provisional classes), 126 classes. Under the Latin schools there were 32 schools with 1 class, 31 with 2 classes, 9 with 3 classes, 11 with 5 classes. The gymnasiums and lyceums numbered 23, the lower Latin schools 42; together, 65 classes.

3. In the public academies there were, on the 1st of March, 1866, in all, 246 definitive head-masters' places (besides 5 provisional ones). Of these, there were—In the seminaries and upper divisions of the gymnasiums and lyceums, 60 places. In the middle and lower divisions of the gymnasiums and lyceums (including the places mentioned above), 64 places. In the lower Latin schools (including 24 assistants' places), 122 places.

4. The number of pupils in the academies was, on the 1st of March, 1866, 4565. Among these were 100 non-Wurtembergers.

If, on the one hand, the pupils in the lower Evangelical schools and those of the Catholic conviction, as well as the pupils in the higher classes of the gymnasiums and lyceums, are taken under the head of gymnasium scholars, and if, on the other hand, the pupils in the middle and lower gymnasium and lyceum classes, as well as the lower Latin classes, come under the head of Latin scholars, the following numbers will be the result:—

(a) On the whole, there were, on the 1st of March, 1866:—1. Gymnasium pupils, 635.  
2. Latin scholars, 3,930. Total, 4,565

### B.—Public Real Schools.

1. The number of public real schools was, on the 1st of March, 1866, 76, of which 9 had special upper real classes.

2. These numbered 160 pupils' classes, of which 17 were upper real classes, and 26 assistants' classes.

These 160 classes were divided as follows:—52 real schools numbered each 1 class. 11 real schools, each 2 classes. 5 real schools, each 3 classes. 4 real schools, each 5 classes. 1 real school, 7 classes. 2 real schools, each 8 classes. 1 real school, 23 classes.

3. There were in all 169, and 143 definitive masters' places. Among the latter there were:—18 head-masters' places in upper real schools (professoriate). 106 real-teachers' places. 19 assistants' places.

4. The total number of real scholars was, 4,734, of which 328 were upper real school pupils. Of these there were:—Protestants, 3,715; Catholics, 793; Israelites, 221; other sects, 5. Total, 4,734.

Of the twenty schools which had the most pupils, Stuttgart, had 988; Neutlingen, 262; Ulm, 248; Esslingen, 224; Heilbronn, 172; Hall, 172; Ludwigsburg, 171; Cannstatt, 121; Biberach, 114; Tubingen, 113; Gmund, 110; Ravensburg, 106; Rottweil, 84; Goppingen, 80; Nurlingen, 78; Freudenstadt, 71; Kirchheim, 70; Caln, 66; Aalen, 60.

#### VII.—ELEMENTARY PREPARATORY SCHOOLS.

The nine towns which have elementary schools under the superintendence of the masters and clergymen appointed by the Minister for Education, and the object of which is the preparation of boys from six to eight years old for entrance into higher schools, numbered, on the 1st of March, 1806, in all, 22 pupils' classes, with 22 masters, and 1006 pupils; of whom 901 were Protestants, 60 Catholics, 44 Jews, and 1 own confession.

Stuttgart	. . . . .	10 classes,	10 masters,	and	404 pupils.
Ulm	. . . . .	3 "	3 "		149 "
Neutlingen	. . . . .	1 "	1 "		112 "
Esslingen	. . . . .	2 "	2 "		95 "
Heilbronn	. . . . .	1 "	1 "		66 "
Ludwigsburg	. . . . .	1 "	1 "		60 "
Cannstatt	. . . . .	1 "	1 "		58 "
Tubingen	. . . . .	2 "	2 "		47 "
Oehringen (provisional.)	. . . . .	1 "	1 "		15 "
		22	22		1,006

An analogous arrangement exists in many of the elementary classes of the country town schools, principally in the real or lower Latin schools with one class, in which the children get extra preparation for their future entrance into higher schools.

#### *Establishments for Private Instruction.*

1. Boys' school, kept by Professor Pfeider, in Kornthal, with 112 pupils; of whom 107 are Protestants, 5 Catholics, 22 Wurtembergers, and 80 strangers; of whom 21 are Germans, and out of the rest of Europe, 46; Asiatics, 2; Americans, 6; and Africans, 5.
2. The educational institution in Ludwigsburg, with 59 pupils.
3. The boys' school of Professor Close, in Cannstatt, with 42 pupils.
4. The private elementary school of Hayer, in Stuttgart, with 136 pupils.

#### VIII.—INDUSTRIAL SCHOOLS.

1. *In the year 1865-66 there were*—In Evangelical communities—394 schools, 32,992 girls, 977 boys = 33,969 pupils. In Catholic communities—504 schools, 17,544 girls, and 644 boys = 18,188 pupils. Total, 1450, with 52,157 pupils, of whom 50,536 were girls, 1621 boys.

2. *Hours of study*:—Number of hours taught in all the schools, 266,691.

3. *Teachers*:—(a) In the Evangelical schools, number of female teachers, 1210. Their salaries together amount to 20,913fl. (1726l.)—so that each mistress has on an average 17fl. 17kr. (1l. 8s. 0d.) (b) In the Catholic schools, the number of teachers is 568. Their salaries amount 10,043 fl. 31 kr. (838l. 11s. 8d.) averaging 17 fl. 40 kr. each, (1l. 9s. 10d.)

Total number of teachers, 1778.

4. *School costs*—books, heating, and working materials:—(a) On the Evangelical side, 32,933 fl. 15 kr. (2747l.), according to which, each school averages 34 fl. 51 kr. (2l. 18s. 5d.)

(b) On the Catholic side, 15,495 fl. 6 kr., according to which, each school averages 30fl. 45 kr. (2l. 11s. 3d.). Total, 48,458 fl. 21 kr. (4,039l. 16s. 8d.)

5. *Grant from the State for this purpose*:—

To the 560 Evangelical communities	. . . . .	7,184 fl. = 598l. 13s. 4d.
To the Catholic side	. . . . .	3,936 fl. = 328l. 0s. 0d.

11,120 fl. = 926l. 13s. 4d.

#### FINANCIAL.

I. The number of masters in the Kingdom of Wurtemberg was, on January 1st, 1867,

##### A.—Schoolmasters:—

1.	With incomes of 400 fl.—424 fl. (33l.—35l.) with house rent free,	1352
2.	" 425 fl.—449 fl. (35l.—47l.) " "	749
3.	" 459 fl.—494 fl. (37l.—40l.) " "	200
4.	" 475 fl.—499 fl. (39l.—41l.) " "	64
5.	" 500 fl.—599 fl. (41l.—50l.) " "	163
6.	" 600 fl.—699 fl. (50l.—58l.) " "	113
7.	" 700 fl. and over (58l. and over) " "	43

B.—Under masters . . . . . 2,684

C.—Ushers . . . . . 299

644

Total . . . . . 3,627

II. The number of masters who taught in classes:—

1. Head masters	. 459	} Sum set aside for their payment, 20,150 fl. (1660l. 16s. 8d.)
2. Second masters	. 76	
3. Ushers	. 18	
	553	} Average income of each master or assistant, 36 fl. 30 kr. (3l. 0s. 10d.)



## PRACTICAL RESULTS OF SYSTEMATIC NATIONAL EDUCATION.

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After giving a comprehensive survey of the system of National Education in the Kingdom of Wurtemberg, in its scientific and technical features and institutions, as well as in its general aims, Mr. Russell, in his *Systematic Technical Education for the English People*, sets forth the results as observed by him in a period of twenty years, on the character, manners, and industries of the people.

Mr. Russell, in his earnest advocacy of systematic technical education of all men engaged in trade, commerce, and arts,—while he does not undervalue its direct and indirect bearing on the material and pecuniary interests of individuals and the nation,—rests its claims on its intellectual, moral, and social results.

In England I should naturally be asked whether all this admirable and systematic organization for the teaching of a whole people, and of which I have said I have carefully watched the progress for twenty years, has been attended with any sensible result upon the character, manners and works of the people of those countries. I should begin by saying that that is in effect asking me—Would the people of these countries be what they now are without that education? and as the two experiments could scarcely have been tried side by side, the answer must be in some degree hypothetical. I will, however, answer this question as best I can.

I begin by saying that when I compare in the same country the persons who had attained maturity before this system was instituted, and that younger generation which has gone through it and come out into the world of practical experience, I say without hesitation that they are more civilized, and that they set about their work in a wiser, shorter, less wasteful way; but this is scarcely a satisfactory answer, for in the interval between the uneducated generation and the educated one, comprising 15 to 18 years, everything there, as elsewhere, has changed in the direction of amelioration.

Perhaps, however, the best standard by which an Englishman can judge of a foreign people is by comparing them individually and personally with ourselves through the medium of their character, their manners, and their works. I will begin, therefore, by saying that when in those parts of an educated country where I am no longer a stranger, I meet an ordinary agricultural peasant, I find him more intelligent, better informed, more able to understand my questions and to give a direct, purposelike answer, than a peasant of the same class in England. He will talk politics to me, because he has read it in his newspaper; he will talk theology with

me, for he studied it at school; he will discuss the Italian question, the Austrian question, and the French question, because at school in the second period he studied their geography, because he is up in their political history, and he knows all that has taken place in his own country from its earliest invasion. I had the good fortune to assist one day in a peasant revolution, as they called it. They were 7000. We stood out in a pour of rain for two hours. The question was whether, to the number of 10,000, the people should sign a paper asking for a change of men and of measures in a part of the country where the same politicians had governed for 25 years. The whole meeting was as orderly and quiet as a ballot for members in a Pall Mall club; the crowd was so quiet that we all distinctly heard one man speak from the platform. I discussed with some of this mob their grievances, which they stated with the greatest good humor. They were the following: That the banks and credit establishments of the district were so organized as to favor the more wealthy borrower as against the smaller landowner or manufacturing borrower, and they wanted the honest poor man to be trusted on the same terms as the honest rich man; second, they conceived that the town districts inhabited by the poor were not so perfectly cleansed and supplied with water as those inhabited by the rich; thirdly, that the character of the education given in the public schools of the second period did not prepare their children for the third period as well as it ought. As to the slightest violence, rudeness, or bad manners, these men would simply have despised any member of the meeting so vulgar as not to know how to behave himself; and I think I can say that in that mob my clothes—and I had dressed like one of themselves—were not touched by those of any other person. I must confess that I came out of that mob humiliated: the gathering corresponded to our Hyde Park meeting, for they were of the lowest class to be found in a populous manufacturing district. They were brought together by demagogues, one a barrister, another a master workman, a third the editor of a newspaper. I will add that it was on a Sunday, and that every one had on a Sunday suit, though some of these suits might have performed that function 10 or 15 years. The petition was afterwards signed to the required number, and the revolution put into due official train. Need I say that of such democrats and such revolutions one need have no fear?

In the daily life in a street in an educated country, I see the absence of rude and rough manners, and I recognize a general aspect of superior intelligence. I call a street porter and give him a message—he sees I am a stranger, and answers me in French, or perhaps in English; I intrust him with some purchases at various shops; on his return, he delivers to me a neat account like the bill of a hotel, properly balanced. One of the items in the account was the purchase of a book. Learning at the publisher's that the book was out of print, he bethought him of going to a bookstall for an old copy. He brought me one as good as new for less than half-price, but never thought of pocketing the difference. Let me next take a waiter at a hotel. We were talking at table of a play by Schiller, which had a French name, which was announced to be played, and of which none of us had before heard: the waiter, finding he could



solve our difficulty, begged pardon for informing us that he had read in the life of Schiller that the play was an adaptation from the original in French by Racine. These are the little things which, in a foreign country, give the stranger a truer measure of relative civilization than more striking characteristics, but when one finds them at every turn pervading the whole structure of society—when one finds in their beer-houses, their cafés, and their dancing rooms, that with some exceptions as to clothes and tone of voice, they are courteous and well-bred, and their countenances full of intelligence and good feeling, one seeks the cause, and finds it in a superior education and consequent superior social condition.

I will now come to the practical matters which show directly the results of a technical education in the production of one of its chief objects—the creation of wealth. It is notorious that those foreign railways which have been made by themselves in the educated countries of Germany and Switzerland have been made far cheaper than those constructed by us in England; it is known that they have been made by pupils of the industrial schools and technical colleges of these countries, and I know many of their distinguished men who take pride in saying that they owe their positions entirely to their technical schools. I find everywhere throughout their work marks of that method, order, symmetry, and absence of waste which arise from plans well thought out, the judicious application of principles, conscientious parsimony, and a high feeling of professional responsibility. In the accurate cutting of their slopes and embankments, in the careful design and thoughtful execution of their beautiful but economical stonemasonry, in the self-denying economy of their large span bridges, the experienced traveler can read, as he travels, the work of a superiorly educated class of men; and when we come down to details, to the construction of permanent way, arrangements of signals, points, and sidings, and the endless details of stations, we everywhere feel that we are in the hands of men who have spared no pains, and who have applied high professional skill to minute details. It is well known that many years before we would follow their example, the engineers of the German railways had introduced a system of constructing and of uniting to each other the iron rails of the permanent way, which made them cheaper, more durable and safe than those employed in England. Happily for our national reputation, it was an Irishman who invented it, though its advantages had first to be appreciated in Germany before we would follow the example.

It is remarked by every traveler that the works of their railway stations are, when compared with ours, much more beautiful, convenient, and fit, both within and without; the construction of their trains, the proportions of their carriages, the fitness, convenience, and comfort of their internal arrangements, all tell to the disadvantage of ours, and the one thing in which our railways excel theirs is in high speed. Theirs, on the other hand, are economical in capital and high in revenue.

It is now so much the practise to praise Prussia, that it is not without reluctance that I have decided to give expression to the result of twenty years of occasional visits to that country. The worship of mere success is so vulgar a feeling that I would not willingly add my voice to that



chorus, but what I now say, I have been saying any time for these twenty years. When first I knew her, she was a very poor country. Territorially she was weak, consisting of scattered patches of land isolated from one another, and surrounded by nations neither loving nor helpful, and even the feelings of the different portions of her own community were anything but cordial to one another. The taxation, as compared to the revenue, was enormous, and the tax in person paid by the compulsory and universal service in the army weighed heavily on the people. The length of frontier to be defended was so great that every working man in the kingdom was compelled to do his work, as it were, with tool in one hand, and musket in the other. It was difficult for an Englishman to see how such a country could be tied together and acquire unity, and nothing but a careful study of their institutions could enable him to do so. In the end, however, I came to see the importance, in a political point of view, of the highly organized system of education which, pervading all ranks, has succeeded in producing two generations of educated men. This education was the same in all parts of Prussia, but by no means the same as in the surrounding portions of Germany. That first gave her an intellectual unity. Another remarkable institution, co-ordinate with this, was the political organization, that, like the education, was of one uniform system through all the parts of the kingdom and through all degrees. I do not think it is very generally known to Englishmen that Prussia is an organized democracy, and is not, as we imagined, governed by the King and an aristocracy. She is governed by an educated democracy, who come indifferently from every rank of society, who receive the highest education the country affords, who are selected entirely by the distinction attained in their technical and learned universities, and who thence rise to fill all the high offices of the State, except those personally surrounding the King, or forming the political government of the time. All the executive government is democracy, educated and organized; everywhere, in the highest offices, exercising the highest responsibilities, are found men of the humblest origin, owing their position entirely to education, ability, and long service. This same civil executive extends through every department of the country, and has its representative even in a small agricultural village. This is another element of homogeneity and unity; it is a system, however, quite foreign to our notions, for it makes a centralized unity of the people and the Government, which, with our unsystematic notions, we detest and vilify with the names of "centralization and bureaucracy," forgetting that there is another name equally appropriate, namely, "organized education and intelligence;" for it is not possible to conceive a more admirable method of diffusing civilization and order throughout a whole people, than to plant in every community, and even in every little village, a civilized, educated man, charged with the single duty of promoting the welfare, education, and order of that community.

The next institution which forms part of the education of the people, and tends to build up the unity of the nation, is that we have already referred to—the perfect training of every citizen to carry arms as a skilled soldier in defence of his country. I have shown how it acts as a direct instrument of education. from the fact that the army possesses an



organized system of schools, in which both men and officers find the means of a finished education. But I have not mentioned the influence of that system on the health, constitution, civilization, and good manners of the people at large. Side by side, in the barrack, in the field, the peasant private soldier and the peer private soldier serve as daily comrades on a perfect level, enjoying the amenities of life and roughing it together. All that we claim for our public schools on the ground of manliness, physical strength, good carriage, manual dexterity, habits of method and subordination, flows equally from the three years' education and discipline of the army, which is thus entitled to be called a university for the people.

But the indirect effects are perhaps greater than its direct influence, for each of these instructed men carries back into the narrow community of his village or town, and into his family, all the civilizing influences of this education.

The last social result of systematic organized education which I will indicate is its effect in imbuing a whole people with a profound spirit of patriotism. I have never seen patriotism more profound or unselfish than in educated Germany and in educated Switzerland; here and there, and everywhere, are to be found individuals conspicuous for large self-sacrifice for the public good, but I am not now speaking of conspicuous persons. What I mean is this: that in those nations the whole mass of the people are individual patriots; personally, they are most industrious, but they will spare any time required from their occupations for the public good, without payment or grudging; personally, they are extremely frugal and economical, but for the common well-being of the community—of the State—of the city—of the village, they willingly impose upon themselves contributions from their hard-won earnings; and, what is perhaps a still higher measure of patriotism than money, men of strong wills, clear views, and energetic personality are ready to sacrifice their own views, preferences, and prejudices to that social organization by which alone unity of action and efficiency is to be obtained for a nation or a community.

That this patriotism is the result of their large education and systematic training I cannot doubt; and I will venture to say that if the governing statesmen of any people desired to secure to their body permanent confidence, fidelity, and attachment, there is no way of implanting these sentiments so surely as by the conviction that the Government had watched over their infant years, had provided for their youth the invaluable blessing of high education, and had never withdrawn its wise solicitude until it had sent them out into life, educated, trained, useful members of society.

These remarks apply rather to the quickened intelligence and raised character of the people than to their material advantages. But I may add that in every country where technical education has taken root, and had time to bear fruit, I also find unquestionable proofs of the rapidity with which increased intelligence and enlarged knowledge bring increase in employment and remuneration. From my personal experience, I may say that within the last twenty-five years I have seen large branches of commercial trade leave one country and plant themselves in another because

the workers of the one were educated and those of the other uneducated; and I have watched nations rising into importance and power in Europe by education, and by the order, organization, and efficiency which education bestows; and other nations lagging behind and losing their place by reason of their unwillingness to educate either the higher or the lower classes of their people. But these material considerations find a better place in the following chapter than here.



## NATIONAL LESSONS IN TECHNICAL EDUCATION.

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Mr. J. Scott Russell, in his valuable treatise on *Systematic Technical Education for the English People*, in a chapter with the above heading, introduces some of the lessons which he thinks may be read in the International Exhibitions of the last twenty-five years.

Of late years, a series of great public events have been taking place, which have been of great national value in serving to awaken the British people from that lethargy of supreme satisfaction with which they have so long continued to regard themselves as the most skilled, accomplished, and successful manufacturing people in the world. For half a century they had been enjoying the fruits of the inventions of a few men of genius who had created the whole system of modern manufacturing machinery, and Providence had also endowed them with the accumulated wealth of countless centuries stored up in the bowels of the earth, in the shape of coal and iron, ready to be used or wasted and worked out in this manufacturing century. The genius of a few men having set coal and iron to do the manufacturing work of mind and man, the citizens of England had begun to think that it was they who were superior in intelligence and civilization to the un-coaled, un-ironed, un-engineered nations around them. For half a century nothing occurred to awaken them from this dream, and for that half century the works of English engineers and English iron and coal bore the highest reputation, and earned the highest prices in the world.

The last eighteen years have seen a series of events, slowly, regularly, and disagreeably awakening the nation from a pleasant belief, once reality, now a dream. Eighteen years ago there began a series of competitive trials of intelligence and skill between the citizens of the different civilized nations of the world. Adam Smith's views of the wealth of nations were to be put to the new trial of competitive examination. The scene of the first trial was in London, in 1851. It was the famous Universal Exhibition of the Industries and Products of all Nations. In that great school the civilized nations of Europe had their first lesson in technical education. There they were able to see in how many things England retained her hereditary excellence; and England was there able to see in how many branches of taste and skill other nations possessed qualities in which she was wanting. But in that competition she had no cause for humiliation. The genius of Paxton would alone have sufficed to rescue the skill and the manufacturing industry of England from humiliation. For in the building of the Crystal Palace in Hyde Park was exhibited an entirely new and highly skillful system of modern architecture, in which iron and

glass, great staples of English manufacture, and of modern invention, formed the sole materials of construction of the largest building of the world, and within which could be seen assembled at one time 100,000 of the people of every nation of the world, surrounded by the products of every clime, and the works of every tribe.

This was England's first great lesson on technical education; the second was the similar Great Exhibition held in Paris in 1855.

Nothing was more striking than the enormous progress nations had made from their first lesson. Some members of each group of human inventions and skill had felt their inferiority, and vigorously set about its redress. England had been struck by the amazing superiority of some continental nations in the beauty and grace of design, which sufficed to convert the rude and nearly worthless materials of clay and flint, which are to her even more abundant than to other nations, into valuable and invaluable works of art, in earthenware and glass. She had occupied the four years' interval under the auspices of the Prince Consort—the real author of these international lessons—in collecting and diffusing through the manufacturing counties the best models of the best masters, in establishing for the potteries and glass works schools of design, and in training teachers for art workmen. These young institutions already bore fruit in 1855, and England was no longer outstripped in pottery and glass. It is curious, but instructive, to notice that the Exhibition of 1851 had disgusted the whole nation with its blue earthenware plates, cups and saucers, borrowed from the 2000 years' tradition of China, and with its huge lumps of glass, called decanters and glasses, cut or moulded into hideous distortions of form.

The largest shopkeepers of London will tell you that ever since that date the old patterns are worthless, save for export to barbarous countries—that all England has learnt a lesson, and made a revolution in taste for these common things.

The lessons which French and German nations had learnt were of another sort. They had felt their inferiority in the great objects of manufacturing and constructive skill, in which, in 1851, we held supremacy. They were happy in having princes or sages as wise as our own, who saw that the great manufactures of England were iron and steel, the great instruments of skill, industry, mechanical power, and transport. They saw that the profusion of our raw materials gave us vast advantages in time and money. They were discriminating enough to see also that in mere raw material, mere mechanical power, and mere brute labor, competition with us was hopeless. And they argued thus: the one thing we can set against the English wealth in raw material is greater skill in using what we have. The way to compete with them in mechanical power is to apply higher science in the treatment and application of it; and the way to compete with them in iron and skill is to buy of them the unwrought material, which they will sell us at nearly cost price, in consequence of their free trade and close competition, and then to apply the skill of our own artisans, highly educated and trained, to construct out of these raw materials all the higher kinds of tools, instruments, and machinery, in those forms and applications which enhance to the highest degree the value of the material.



In 1855 we saw that the French and the Germans had already advanced far into our own provinces of iron, steel, and metal manufacture. We found that they had already established schools in every metropolis, large town, or center of industry, for educating professional men and masters, for training foremen and skilled workmen, and for educating apprentices. What we saw in 1855 was instructive to the clear-sighted and the thoughtful, but it was not humiliating to the mass of the English visitors, and it did not alarm the English manufacturers. Therefore, unhappily, they did not take warning in time. They merely committed the common blunder of despising their rivals. When they saw the enormous progress of the French in steam machinery, and its metal products occupying a huge annexe, they merely said: "Look! they have been imitating us; but never mind, these are mere *tours de force* got up under the patronage of the Emperor to make a show at his Exhibition. They serve to gratify the vanity of the French nation. but they can never compete with us in quality, quantity, or price."

This self-satisfaction was a huge blunder. The progress of the French and German nations has shown there was an ominous reality.

The third lesson was our own Exhibition of 1862. It was the first Exhibition humiliating for us. Our administration of that Exhibition was humiliating, for it was a grand administrative failure. The building itself was to us, as an intellectual, mechanical, and artistic nation, an abject humiliation. Hideous on the outside, without unity or effect as a whole; inconvenient in the inside, ugly in its details, crowded and unseemly in the distribution of the objects exhibited, with but a single portion of it serving rather to exaggerate than redeem the effects of the other—an admirably arranged, lighted, and ventilated picture-gallery. Paxton was still alive, and also the distinguished men who, allied with him, had created the Exhibition of 1851, and had afterwards transported it to form the Crystal Palace on Sydenham Hill, there to serve as an enduring monument of our first great national lesson in technical education, and as a permanent institution for the refinement of the taste and culture of the people. Though Paxton was still living, his genius was not permitted to serve the nation, and that nation felt that the quickest way to spare itself from perpetuating its own disgrace and humiliation was to sweep off the face of the earth this disgraceful monument of its want of foresight, design, and organization.

Thus disgraced by the edifice itself, there was little to be seen in the interior to give an Englishman cause for self-gratulation. Switzerland had there her wonderful aniline colors, the discovery of her distinguished chemist, Schönbein. Prussia was there with her huge ingots of Krupp's steel—already beginning to displace on English railways the finest qualities of Yorkshire iron. America was there with some of her exquisite machinery for economizing labor. Italy was there with her already reviving manufactures of classic earthenware, her decorated glass, and her Etruscan gold. France had been diligently following up her determination to equal us in our great staples of machinery and iron manufacture, and the stately steam-engines she then produced, as examples of her ordinary work in the steam-ships of her navy and mercantile marine,

sufficed to show us that her progress was true, and that we had been mistaken in calling her triumphs of 1855 *tours de force*. All around us in that Exhibition were proofs that every nation had begun to rival us in some one of our great specialties; and if we were not instructed, we were at least sufficiently disgusted with that Exhibition to feel, and to express a very pervading conviction, that for our part we would cease to repeat Exhibitions which failed to mark any progress of ours, and only served to advertise to the world the more rapid progress of rival nations. That feeling of disgust was the first wholesome symptom, but it did not at that time mature itself into any conviction of the necessity of any great national exertion to advance the manufacturing skill of the English people. We had exhibited a sufficient number of new iron Armstrong guns, and models of iron and iron-coated men-of-war, to make us feel that in all things we were not yet distanced.

It was the Exhibition of 1867, in Paris, which gave the nations, and especially England, a final lesson. By that Exhibition we were rudely awakened and thoroughly alarmed. We then learnt, not that we were equalled, but that we were beaten—not on some points, but by some nation or other on nearly all those points on which we had prided ourselves.

I shall shortly sum up the practical conclusions which I myself, and the most eminent of my colleagues, arrived at. We were sent by the British Government to serve as jurymen in adjudging the awards of the Exhibition, and to report to the Government the practical facts of national importance which we might there observe. In the great manufactures of iron men-of-war, with their huge steam-engines, ponderous wrought-iron armor, we found ourselves equalled, if not beaten. The large marine engine of Dupuy de Lôme neither excelled the English marine engine in exquisite truth of workmanship nor in high finish, for I have elsewhere said that the English workman's conscientious pride in his work is not to be excelled by that of the workmen of any other country. But the design of the French engine showed so much fore-thought, practical wisdom, and provision for economy, as left no doubt that it would consume less fuel, do more work, endure longer, and run less chance of accident than our own engines; all of these being qualities heretofore constituting our own superiority.

Next in iron armor. Their ships carried iron armor as thick and as strong as our own, and they were armed with guns and supplied with ammunition which could just penetrate that armor, but which that armor was just able to prevent from piercing. And their ships presented arrangements for securing all the advantages of simultaneous firing in every direction which we had claimed for ours, with this additional advantage, that the French had attained that which we had at enormous expense tried but failed in obtaining—efficient breech-loading guns, which enable them effectually to deliver 17 shots to our 10.

Thus our naval supremacy was shown to be ended, so far as the manufacture of *matériel* and mechanism is concerned.

Coming to land-machinery and structures, we found, in the French department of the great building, a multitude of steam-engines of French manufacture, and even from distant provinces, distinguished by our own



perfection of mechanical execution and high finish, but distinguished also beyond any of our own for the elegance and perfection of their mechanism and arrangements for economy. With the French, fuel is dear; they find it worth while to fetch it from England and pay the freight, but they have set their minds to compensate this inequality by their superiority of design and contrivance. So they not merely invented boilers well calculated to endure, keep clean, and extract the largest quantity of heat out of the fuel and to make with it high and strong steam, but they also contrived the engines in such a manner as to turn that steam to better account than in our engines, so as to get more power out of a given quantity of fuel, in a higher proportion even than the greater cost of our own fuel exported into France—a clear triumph of forethought and ingenuity over wasteful, unthinking wealth.

There was but one steam-engine which rivalled them, and that was more the contrivance of the American than of the Englishman whose name it bore.

But perhaps the most remarkable group of all the exhibitions in Paris, was the group of large manufactures in iron which showed the products of the furnaces, forges, and iron-mills of France, Germany, and Belgium. Everywhere in rails, railway-wheels, railway tires and axles; in large wrought-iron beams for house building, in iron plates and bars, and frames for iron ships—in these, which were all our own, we found ourselves rivalled, excelled, in size and quality, and competed with in price. On land, therefore, as well as at sea, our mastery of the iron trade seemed to have disappeared.

In smelting, mining, locomotive building, and the great branches of commercial machinery, a single great establishment in France, called Creusot, appeared like a chivalric knight to issue a challenge against all England.

Creusot possesses the natural advantages of England, inasmuch as under its own soil it has the iron, the coal, and other minerals, in the same abundance as ourselves. But Creusot, under the wise direction of President Schneider, was endowed with an advantage which we have neglected—the possession of a systematic organization of technical schools. Creusot has a generation of workmen schooled and trained on the spot. The schools are a model which we shall long emulate in vain. It will take us twelve years to overtake Mr. Schneider. He imports his locomotives even into England; and all round the coasts of France, and round her inland borders, Schneider serves with locomotive engines, iron plates, and forgings, customers who used to come to us for these commodities. It is not in price merely that he competes with us. It happened to me to be professionally occupied in a foreign country where the iron for a large engineering undertaking was about to be contracted for. Competitive tenders were obtained from some of the best works in England, and from Creusot. The prices were so near as to have little influence on the result, but they were slightly in favor of the English manufacturer. The contract was given to Creusot, and when I inquired officially the reason which had sent the contract to France, I was informed that they could more perfectly rely on the uniform excellence of the quality of iron from Creusot than

from England—a result to an English engineer sufficiently humiliating. I asked the value of this character in the opinion of the buyers, and was answered that they considered it equivalent to more than five per cent. in favor of France.

Another fact of the same sort in the same place expressed the same conviction. The large iron forgings which were imported for the same work, came from France, not England. The answer received this time was that the large forgings were cheaper in England than in France, but that in France the forgings were so much better formed to the finished shape as to be worth more than the difference in price.

I have dwelt on these instances mainly because they are in departments in which I can venture to express a professional judgment. In the Prussian department were triumphs of technical skill, palpable to all observers. Steel cannon, more powerful than any of our own, carrying larger shot with heavier powder charge. Large ingots of steel, of magnitude and quality unequalled by any nation. Tires of locomotive wheels, which, imported into England, supersede our own highest qualities of iron; and complicated members of machines forged by Krupp out of a single piece of steel so as to be equivalent to eight or nine of the old pieces, formerly fastened imperfectly into one. These were some of the triumphs hastily exhibited by Prussia, even at the end of her costly war.

I will not weary the reader with further observations of my own.\* I have said enough to let him understand how the Exhibition of Paris startled a thinking Englishman, and ended by convincing him that England had been asleep, and that a whole generation of wakeful, skilled workmen had been trained in other countries during the interval between 1851 and 1867. Fifteen years is the time necessary to train a generation of skilled men. Some nations had already possessed that time and turned it to that account, with the results we then saw in Paris.

That is a lesson on no account to be lost. It is the crowning lesson of the series begun in '51, and it is the intention of the following evidence to impress on Englishmen, from the legislator to the craftsman, the great fact that we have let one generation grow up uneducated and untrained, and that no question now remains for us but this: shall we now allow a second generation to grow up equally untrained, unskilled, and left behind in the race?

I now, therefore, proceed to give the opinions of qualified men, who have, with extraordinary pains, gathered the lessons and moral of the Exhibition of Paris for the benefit of the English people. A new organization was provided, of which we can scarcely imagine the full value to have been apprehended at the time it was initiated. There were, of course, the usual reports of the jurors and the prizes which followed their awards; but awards and medals became so profusely showered that their number nearly neutralized their value. Besides, and, we may say, above and beyond the jurors, was a higher series of reports prepared by Special Commissioners sent to report on the results of the Exhibition, with reference to national

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\* The reader who desires more information than is given in this chapter, will find it not only in the works themselves from which the following extracts are made, but in the reports of the juries and of our own government reporters, which are published in a separate volume.



interests, and the large number of their reports have already been printed and have already appeared in a series of "Kensington Blue Books." A second series of reports, of a still more strictly technical nature, was elicited by the Commissioners of Schools, who had ascertained that many of the reports on the French Exhibition appeared to throw the blame of certain cases of inferiority on the lower technical education of the British people, and the commission issued a series of inquiries of which they then published the report.

On this report the Government, having taken alarm, sent abroad a Commissioner, if not officially, at least *officieusement*, to ascertain by personal inquiry whether the alleged defects of our systems of education and our inferiority to some other countries in some sorts of technical skill were real or imaginary; and we have in the report of Mr. Samuelson to the Vice-President of the Council of Education, the views of a practical manufacturer concerning the previous statements. All these sources of information agree on three points,—on the great practical value of education to a people; on the admirable organization provided by the Governments of other countries for giving to their people systematic and universally-diffused technical education; and, thirdly, on the deplorable neglect of such measures which has characterized our own Government and people.

But, in my estimation, there is a collection of documents of far more importance than all these put together, which has just been published in an unassuming form by the Society of Arts, and issued from their rooms in the Adelphi, at the small price of half-a-crown. I doubt whether the Society itself clearly saw what it was about when it undertook the harmless, beneficent duty of offering to pay the traveling expenses of such English artisans as wanted to study their own departments of trade in the French Exhibition, and could not afford the cost; and when in return for this benefit it imposed the modest condition that they should report in writing on what they had seen and learnt. Out of this simple act has grown a collection of reports, 689 pages of closely printed matter, full of subject for the gravest thought—treating, in fact, the whole question of the social condition, moral and religious education of the workman, and of the duties which various Governments have either neglected or performed, in giving or withholding from the youth of a nation that intelligence, skill, and taste which they unanimously declare education can promote and develop, if it cannot create. It is the quiet, reasonable, practical, and moderate tone in which all this has been investigated and set down, which renders this volume the notable contribution to social science in 1867.

Of all these four separate sources of knowledge, I should wish to convey to my readers the aim, the substance, and the conclusions. I fear I shall not be able in one chapter to overtake all of them, for the field is both wide and prolific, covering nearly all the branches of human industry.

I. Taking up first the "Report relative to Technical Education by the Schools Enquiry Commission of 2d July, 1867," I find the Commissioners issuing a request for information to some eminent jurors and others as to the truth of certain "evidence considered to be afforded by the International Exhibition at Paris of the inferior rate of progress in manufacturing and mechanical industry in England, compared with that made in

other European countries ;” and they add, “ it has been stated to us that this alleged inferiority is due in a great measure to the want of technical education, and we have therefore thought it desirable to ascertain from many eminent English jurors in this department whether they agree with this opinion, and we think it expedient at once to report to your Majesty the answers which we have received to our inquiry on this point.”

The gentlemen whom they consulted, and whose answers they have printed, were: Dr. Lyon Playfair, F.R.S., Professor Tyndall, F.R.S., Dr. David Price, J. E. McConnell, C.E., James Young, chemical manufacturer, J. Scott Russell, F.R.S., Captain Beaumont, R.E., Robert Mallet, C.E., Rev. Cannon Norris, M.A., Professor Frankland, F.R.S., John Fowler, C.E., Warrington W. Smythe, F.R.S., E. Huth, Peter Graham, A. J. Mundella, W. Spotten, thus representing many of the most important departments of our educated professions, our applied sciences, engineering, education, and manufactures. I shall content myself with giving the essence of these opinions

Dr. LYON PLAYFAIR gives, as the result of his own inquiry as a juror, and of those of other jurors: “ A singular accordance of opinion prevailed that our country had shown little inventiveness, and made but little progress in the peaceful arts of industry since 1862. . . . Out of ninety classes there are scarcely a dozen in which pre-eminence is unhesitatingly awarded to us. . . . The one cause upon which there was most unanimity of conviction is that France, Prussia, Austria, Belgium, and Switzerland, possess good systems of industrial education for the masters and managers of manufactories and workshops, and England possesses none.”

Professor TYNDALL says: “ I have long entertained the opinion, that in virtue of the better education provided by continental nations, England must one day, and that no distant one, find herself outstripped by those nations, both in the arts of peace and war.”

Mr. HUTH writes: “ I am sorry to say, that although we may still be unsurpassed in many of our productions, we no longer hold that pre-eminence which was accorded to us in 1851. . . . The enormous strides that have of late been made by our continental rivals in France, Belgium, Prussia, and Austria, will make it daily more difficult for our woolen manufacturers to hold not only their former prominent position, but even to maintain their present one. . . . I found that it is the want of industrial education in this country, which prevents our manufacturers from making that progress which other nations are making. . . . I found both masters and foremen of other countries much more scientifically educated than our own. . . . The workmen of other countries have a far superior education to ours, many of whom have none whatever. . . . Their productions show clearly that there is not a machine working a machine, but that brains sit at the loom and intelligence stands at the spinning-wheel.”

Mr. McCONNELL says: “ In the class for which I was juror for England, I made a very careful examination and comparison of our locomotive engines, carriages, railway machinery, apparatus, and *matériel* with those exhibited by France, Germany, and Belgium. I am firmly convinced that our former superiority, either in material or workmanship, no longer exists. . . . Unless we adopt a system of technical education for our work-



men in this country, we shall soon not even hold our own in cheapness. . . It appears to me, Government should take the matter in hand. . . There should be mining schools in South Wales, Staffordshire and Durham; and machinery and engine schools in Manchester, Glasgow, &c."

Professor FRANKLAND says: "As a juror in Class 44, of the Paris Exhibition, I was not only forcibly struck by the want of evidence of progress in the different branches of chemical manufactures carried on in Great Britain, but still more so by the great advances made by other nations, especially Germany, France, and Switzerland, in respect of such manufactures, since 1862, when, as a juror in the corresponding Class, I had also an opportunity of comparing the chemical manufactures of different nations. . . In the Polytechnic schools of Germany and Switzerland, the future manufacturer or manager is made familiar with those laws and applications of the great natural forces which must always form the basis of every intelligent and progressive industry; it seems that at length this superiority in previous training, is more than counterbalancing the undoubted advantages which this country possesses in raw material."

Mr. MALLET says: "I fully agree that a better system of technical education for all classes connected with industrial pursuits has become a pressing necessity in Great Britain, and that immediate steps ought to be taken for organizing and procuring, legislatively, such a system;" he has been long convinced that "unless checked by a vast improvement in our own educational system, general and technical, the pre-eminence of England must decline with a rapidly accelerating pace."

Mr. DAVID PRICE says: "What is really wanted for this country, and is of vital consequence to our future prosperity, is a higher scientific culture of those who are likely, in the natural course of events, to be master manufacturers; so that when discoveries are made they may fructify, and not stagnate or decay, as has too often been the case, for want of intelligence on the part of those who command capital and works, to see their merits."

The evidence given by other jurors is not less strong, but I can only spare room for one more quotation, that of Mr. MUNDELLA:—"The branch of industry with which I have been connected for thirty years, is the manufacturing of hosiery. I am the managing partner, employing 5000 work-people; with establishments in Nottingham, Derby, and Loughborough, employing 4000, and with branches at Chemnitz and Pausa, in Saxony, employing about 700 persons. I have, for four or five years past, been increasingly alarmed for our industrial supremacy, and my experience of the Paris Exhibition has only confirmed and strengthened my fears. . . . I am of opinion that Englishmen possess more energy, enterprise, and inventiveness than any other European nation. The best machines in my trade now at work in France and Germany, are the inventions of Englishmen, but are there constructed and improved by men who have had the advantage of a superior industrial education. At the largest establishment in Paris, these machines are constructed and improved on thorough scientific principles, under the superintendence of a young man, who, I was informed, took high honors at the school of the Government in Paris. . . . Precisely the same thing is taking place in Saxony; but the Saxons are, in

respect of education, both primary and industrial, much in advance of the French, and in my branch, they are our most formidable rivals. . . . The contrast betwixt the workpeople of Saxony and England, engaged in the same trade, is most humiliating. I have had statistics taken of various workshops and rooms in factories in this district, and the frightful ignorance they reveal is disheartening and appalling. . . . In Saxony our manager, an Englishman of superior intelligence, and greatly interested in education, during a residence of seven years, has never met with a workman who cannot read or write—not in the limited and imperfect manner in which the majority of English artisans are said to read and write, but with a freedom and familiarity that enables them to enjoy reading, and to conduct their correspondence in a creditable and often superior style. Some of the sons of our poorest workmen in Saxony, are receiving a technical education at the Polytechnic schools, such as the sons of our manufacturers cannot hope to obtain. . . . I am of opinion that the English workman is gradually losing the race, through the superior intelligence which foreign governments are carefully developing in their artisans. . . . The education of Germany is the result of a national organization, which compels every peasant to send his children to school, and afterwards affords the opportunity of acquiring such technical knowledge as may be useful in the department of industry to which they are destined.” His concluding sentence ought to carry great weight—“If we are to maintain our position in industrial competition, we must oppose to this national organization one equally effective and complete; if we continue the fight with our present voluntary system, we shall be defeated, generations hence we shall be struggling with ignorance, squalor, pauperism, and crime; but with a system of national education made compulsory, and supplemented with art and industrial education, I believe, within twenty years, England would possess the most intelligent and inventive artisans in the world.”

II. It is no wonder that, with such a report, made to her Majesty, from such a Commission as that of which Lord Taunton is chairman, the Committee of Council on Education should have thought it necessary to obtain some little information as to what other countries were doing for the technical education of their people. They solicited, through our representatives abroad, such printed papers as the various governments could give them, regarding the organization of technical schools, and we learn that they are translating some of these for public use. They also requested Mr. Samuelson to visit, or accepted his offer to examine (for it is not quite clear which), manufacturing industry abroad, in its relation to technical schools; and the result is a letter addressed by him to the Vice-President of the Committee of Council on Education, moved for by the House of Commons, and printed in November last.

Mr. Samuelson, M.P., traveled in France, Belgium, and Germany, examining, as he went, the most famous manufacturing establishments on the Continent, which stand in direct rivalry to our own. He found everywhere in these establishments men of all ranks better educated than our own; working men less illiterate—foremen and managers well educated, and masters accomplished, well-informed, technical men. He traced out the pupils of technical schools to their practical and successful results, as



the superintendents of large works, and he sums up the results of his examination, in a paragraph which appears to confirm all the reports made to that Commission, which was the origin of the inquiry.—“I have attempted to show, by examples, what is the condition of some of the leading industries in these countries, (France, Switzerland, and Germany). I do not think it possible to estimate precisely what has been the influence of continental education on continental manufactures. . . . That the rapid progress of many trades abroad, has been greatly facilitated by the superior technical knowledge of the directors of works everywhere, and by the comparatively advanced elementary instruction of the workers in some departments of industry, can admit of but little doubt. . . . Meanwhile, we know that our manufacturing artisans are imperfectly taught, our agricultural laborers illiterate; neither one nor the other can put forth, with effect, the splendid qualities with which Providence has endowed our people. Our foremen, chosen from the lower industrial ranks, have no sufficient opportunities of correcting the deficiencies of their early education; our managers are too apt, in every case of novelty, to proceed by trial and error, without scientific principles to guide them; and the sons of our great manufacturers too often, either despise the pursuits of their fathers, as mere handicrafts, unworthy of men of wealth and education, or else, overlooking the beautiful examples which they afford of the application of natural laws to the wants of men, follow them solely as a means of heaping up more wealth, or, at the best, for want of other occupation: to the evils of such a condition, not only our statesmen, but also our people, are rapidly awakening, and the disease being once acknowledged, I believe the remedy will soon be applied.”

III. In the two preceding sections, we have been occupied with what we may call the upper side of the question, that is to say, we have seen it from the master's point of view, and we have also seen how it is regarded by men of science, of education, and of distinguished technical skill. Let us now see how the questions of technical education and manufacturing supremacy are regarded from the workman's point of view, and so try to understand the under side of the question.

What do our technical workers think of their own skill, intelligence, taste, judgment, knowledge, culture, refinement? What do they think of their education, of their school training and apprenticeship? What do they think of the opportunities provided for the matured workman, who wishes to study, to copy, to increase his stores of science, and rise to higher grades of skill? What do they think are the duties of Government to him and his fellows? Do they think foreign governments wiser in their care for their working people than ours? Do they think the systematic education of their people to be waste of pains or wise foresight? In short, do they find in the institutions of any other country, any social amelioration which they would wish to introduce into their own?

On all these points, and a great many more, we have the evidence of fifty-five witnesses, all workmen, most of them evidently superior workmen, and who are entitled by their acquirements to be termed at least, self-educated men. Among so many witnesses, we cannot call up all; but as we have enjoyed the pleasure of reading the whole book, we will

only call such witnesses as appear to have made a special study of each point.

1. *On Early Technical Training.*—Mr. LUCRAFT, the chairmaker, says: “Seeing some lads at work with the men in the carver’s shop, I went to the bench of one about fourteen—he was carving a chair-back, of a mediæval form, from a working drawing. I expressed my surprise that one so young was found capable of carving so well, and was informed that boys at school are specially prepared for the trade they fancy, so that a boy about to be apprenticed to learn carving, is instructed in ornamental drawing, modelling, and designing.” . . . Further, “I am bound to repeat that in the race we are nowhere. . . . Without the least doubt or hesitation, yet, with the most profound regret, I say that our defeat is as ignominious, and I fear as disastrous, as it is possible to conceive. We have not only made no progress since 1862, but it seems to me we have retrograded.” He adds that the mere mechanical workman stands not the slightest chance with the workman of a cultivated taste. . . . “The art-workmen of France have a great advantage over us in England; in Paris they are surrounded by works of taste which none but the most obtuse can long remain uninfluenced by; their museums are central and numerous; they are surrounded by works they venerate and love, and their very nature gets impregnated with them. . . . Something must be done, or the working classes will be grievously wronged, and the whole nation suffer.”

The lacemakers of Nottingham say—“We are unanimous in opinion, that French laces display a decided superiority in design and quality of material over the English goods.” They express the hope “that the time is not far distant when some national system of compulsory education will be brought into existence to lessen the ignorance amongst us, and place our country on an equality of intelligence with other nations”

Messrs. KENDAL and CAUNT, hosiers, say—“We observed, as a rule, that the French people did everything with the greatest ease and tact, and without much labor, and always made a good finish of what they took in hand, so that nothing could be much improved after they had done with it. . . . On the whole, we are of opinion that the French have made great progress of late years, and that they are continuing to progress; and there can be no doubt that the superior education that is given to the working classes on the Continent, gives them an advantage, in some respects, over Englishmen; but there are no workmen so quick and so inventive as our own, as far as we are able to judge.”

Mr. CONNELLY, stonemason, says—“The Frenchman’s familiarity with art, and his early training in its principles, enables him to outstrip us; and as every building in Paris is more or less decorated with carving, you are at a loss to know how they get all their art-workmen; but the difficulty would not appear so much, if you could read the large placards, in French, which are posted up at the ends of the bridges, and other public places, informing workmen where they can be taught drawing and modelling every evening, free of expense. That he outstrips the Englishman, in this respect, does not, I feel certain, arise from the possession of an especial art genius, but because whatever of it is in him, is fully developed, and encour-



agement is given to its practice; and if English workmen are behind in this respect, it is not because art genius is deficient in our nature, but because it is not developed and encouraged sufficiently. . . . It is impossible to estimate the loss which is entailed upon England through the neglect of art culture in every department of our industry; through it we are reduced to mere 'hewers of wood and drawers of water' for other nations. The bulk of our manufacturing population is engaged in manufacturing goods to be sold cheap, or in producing raw materials for other people to work. . . . On a ton of iron, for the labor of which we get less than 1*l.*, they are sure to put 100*l.* of labor before it leaves their hands."

2. *Artisans' Opinion on the Responsibility of a State for the Technical Education of its People.*—Mr. RANDALL, china painter, says—"When we come to high-class ornamentations in iron, earthenware, china, or glass, the superiority of French art is obvious. As long as we confine ourselves to geometrical forms in hammering, pressing, turning on the lathe, or printing on the surface, we have no difficulty in holding our own; but where an intellectualism is concerned, or a free educated hand is required in decoration, our deficiencies become apparent. The fault is less our own than our rulers', who have denied us education, or who have at least, given us nothing to fit us for our destination in life, but have left us groping in the dark, for ever feebly attempting to overtake lost opportunities. . . . As we heard an English workman, in another branch of trade, observe in Paris—there is much more credit to an English workman if he is clever, for a Frenchman has so many advantages, that if he only has moderate talents, he can scarcely help but be a good workman. He has excellent schools to give him a primary education, and, go where he will, there is something to educate his eye and elevate his taste. We have been groping our way in ignorant and bigoted security, and quarreling in which way education should be given, or denying it altogether, while other nations have been getting before us; and if this Exhibition have no other effect in England than to convince us of our deficiencies, it will have had its mission—so far as we are concerned. The present prosperity of this country is so unmistakeably interwoven with its manufactures, and the pre-eminence of these depends so much upon new adaptations, discoveries, and improvements, as to demand for the workers in iron, china, and other departments, the readiest and best educational training and enlightenment this nation can give them. It is not only idle, but suicidal, to dream of remaining where we are. We must strike out in new paths. We must advance with the world, or lose caste and trade together. How many men know anything at all of the materials with which they work? Yet such knowledge would sweeten daily toil, would open the treasure-house of thought, enable a man to convert to new uses, elements of force by which he is surrounded, and enrich the nation by adaptations and modes of economizing means now in use. Every man ought to have the means within his reach to enable him to become master of his art. With how many would a knowledge of geology, chemistry, geometry, drawing, and mechanics, smooth the path of daily toil, and render labor pleasant! Why should not the miner find compensating pleasure for the darkness and drudgery of the mine, in a knowledge of the gases by which he is surrounded, and of the minerals he is extracting



from their long resting-place in their subterranean storehouse? Let him know something of their history, of the changes and natural processes to which they were subject to bring them to their present state. How cheaply purchased is the pleasure of astonishment with which he might go on reading the hieroglyphics and paintings of Nature in the mine, interpreting at each stage, the emblems of earlier states and existences. Such an education would tell in many ways. All that we ask for is, that the State should fulfill efficiently unquestionable and admitted duties, rather than disputed ones. We have no wish for interference in a way that may weaken, in the least, a proper sense of individual responsibility, that may lessen the slightest individual energy, or offend the sensibilities of the strictest advocates for economy in the resources of the nation. Government for the future will—if there is any meaning or force in the late political changes—be more than ever the delegated power of the people to execute its will in legislating upon the admitted ‘Benthamite’ principle of the greatest happiness to the greatest number; and whilst doing so, it will undoubtedly seek to carry out the injunctions of the wise in all ages, from Solomon downwards, and supply education to those who are supposed to be deficient of the will, or the means of obtaining it. What we complain of, and what the country raising the taxes to support the present system complains of most, is that, being in the hands of the clergy, and under inspection by men drafted from them, it is used as a proselyting scheme, rather than an engine for fitting children for their duties in life. They are crammed with catechisms, Jewish pedigrees, with things pertaining to the past, which have no relation whatever to their future modes and pursuits of life, without being taught at all, the means by which their own wonderful and diversified faculties might be made to bloom in profitable fruition, so that both the individual, and the State itself, should be compensated—each having its positive welfare secured thereby.’

Mr. WINSTANLEY says: “I should like to see a number of institutions—they might be called colleges, or any other name. I would have them fitted up with a number of workshops for different trades, and one large room to be used as a lecture room, and for periodical exhibitions. I would have lectures delivered twice a week, by the best professors, upon different branches of art manufacture. There should be a well-stocked library and reading room, all on art manufacture. There should be schools attached, for drawing and modelling. Why I propose workshops is, because working men, in large towns, have a great difficulty in finding convenience to do anything for themselves, by way of improvement. . . . I would also have a committee, or council, established by Government, or the Society of Arts, that should receive working men presenting certificates for examination in their different branches, and grant them certificates according to their merits.”

Mr. MACKIE, wood-carver, reports: “I visited the *Ecole Impériale Spéciale pour l’Application des Beaux Arts à l’Industrie*. On that occasion there was an exhibition of the works of the students, and the number and variety were considerable and interesting. Conspicuous among the exhibits were some large models in clay. The Minister of Instruction had dictated the subject, and the following were the particulars given. A somewhat



large tympanum of a pediment, to have the head of a bull for a center, resting upon a shield, with accessories of boys and festoons of fruits and flowers. The best was a very successful interpretation of the order given. These studies were little more than good sketches in clay, but it was evident that the students were learning a most useful lesson, that would stand them in good service when they went forth into the world. . . . It seemed abundantly clear that the system pursued was simple and rapid, and that the teaching and practice produced valuable results. It seems to have great vitality, never being without deep and varied interest to the student, features that should distinguish every school, and without which they will assuredly fail in accomplishing the objects sought to be obtained. A visit to the exhibition of the works of the students of the Ecole Impériale Spéciale de Dessin pour les Jeunes Personnes, showed that the young ladies practised the same system with very profitable results. I am informed that the fees are little more than nominal, the main expense of the schools being borne by Government."

Mr. WHITEING, in his special report, says on the subject: "The notion of the functions of Government entertained in this country would not be tolerated for a moment across the Channel, and it may be doubted whether our dislike to what is called special legislation—to legislation, that is to say, which proposes as a direct aim the improvement of the social condition of our people, has not its weak as well as its strong side. The constant difficulties experienced by individuals struggling alone to effect social reforms, often never aided by Government till the necessity of all aid has passed away, would seem to indicate that it has. From the view of the obligations of Government taken by the French people, it necessarily arises that instruction, both superior and elementary, has long held that recognized position under the protection of the State, which it is only just beginning to have here. A due provision for art education, for instance, is no favor on the part of the administration, but one of the conditions of its existence. In every town of any importance, in a manufacturing point of view, in every district of all the principal cities, there is to be found the art school, just as there is to be found the church or the baker's shop.

. . . It is not denied that similar institutions are to be found in our own country, but among us there is a very perceptible want of Government responsibility for the welfare of the schools, and they are not placed under the direct patronage of the officials of the district, who, in France, commonly attend to give a solemn character to the distribution of the awards. . . . In France, the Minister of Instruction has confided to him, as it were, a nation in a certain state of knowledge, and he is expected when he resigns the seals of office, to show that under his care that nation has steadily progressed; he may demand certain aid from the Government; his claims have a recognized place in the budget, and he is entitled to speak by the admitted importance of the interests over which he presides. It would be well if with us some such system could be devised, in place of that which gives us an irregular and spasmodic support to art, on the part of our public representatives, and which too often leaves its fate in the hands of only one or two well-meaning members of parliament. . . . What is above all wanted, is Government countenance



as well as Government aid. In France, as we have seen, the distribution of prizes, the opening of schools, is always made more or less a ceremony; the whole population of the district in which the school is situate, cannot fail to hear of what is going on. Publicity and *éclat* are given to all the proceedings, and the school immediately reaps the benefit. Of course, it is not to be inferred that the Government of France does everything for art education, and private individuals nothing. There is a considerable amount of private patronage, though to nothing like the same extent as among us; but it is always desirable to substitute for the irregular action of individuals, however well disposed, the order, economy, and persistent effort of an efficient body. . . . Let us now consider what the State does for education in France, both for primary instruction and for the special training acquired later, when an art or trade has been chosen. The system of primary instruction so very much resembles our own, both in the nature of the instruction given, and in the mode in which support is obtained, that no detailed account of it will be necessary. . . . But it is in the facilities for the higher education which ought to follow this primary teaching, where the inclination exists, that the great divergence between the English and the French begins. The ease with which a poor boy may obtain an entry to one of the imperial lyceums, or large public schools which prepare for the universities, and thence go up to the universities, which very properly are in the capital itself, and are all free, is something marvellous, and is only equalled by the excellent facilities of a like kind which exist in Germany. . . . The technical education of French workmen is of two kinds, elementary and advanced. In the first, the child having been early destined to a particular trade, is placed in an institution, where he serves a kind of preliminary apprenticeship to that trade, and where primary instruction goes hand in hand with the special training requisite to give him a more enlarged knowledge of his business. These technical schools for children are, however, only just beginning to be established, but the results in the last of which accounts were published, were in the highest degree satisfactory. The children are occupied, in all, about nine hours of the day. . . . In the morning they receive instruction of the ordinary kind, which is also given for an hour in the evening, and during the day they work, in every respect, as if they were apprenticed to private individuals, only that a certain portion of the time is devoted to teaching them the rationale of their art. . . . It has been stated that at present these institutions are very few in number, as hitherto they have only been regarded in the light of an experiment, so that only a very limited number of trades can be taught in them, but there is little doubt that as an experiment they have been successful, and that when their success shall have obtained general recognition, the Government will take measures for establishing them in all the principal towns.

An equally important tentative effort in the way of technical education has recently been made in the establishment, under government patronage, of an institution for the higher technical training of youths—that is to say, for the union of the highest theoretical with the best practical teaching in the manufacturing arts. This institution is somewhat in the nature of the *Ecole des Arts et Métiers*, only it is not so exclusively theoretical as



that, but aims at supplying a want long felt in France, namely, that of skilled foremen competent to superintend, or at least fully understand all the operations of a large manufactory.

Mr. ATKEN, of Birmingham, in his introductory report, which heads the reports of the Birmingham artisans, says: "Industry, formerly unaffected by foreign rivalry, contended only with small producers of its own nation, and then the competition was small. But free trade has thrown down the barriers, and the world is now one mighty, universal market. To be successful in this competition, our nation (England) must, therefore, put forward all its energies to educate in technical, and other schools, the present and coming generations; this was anticipated and clearly seen. Humboldt, many years ago, foresaw and predicted 'that the time was not far distant when science and manipulative skill must be wedded together; that national wealth and the increasing prosperity of nations must be based on an enlightened employment of natural products and forces.' Justus Liebig said: 'The nation most quickly promoting the intellectual development of its industrial population must advance, as surely as the country neglecting it must inevitably retrograde.' Peel saw this when he uttered the memorable words, 'If we are inferior in skill, knowledge, and intelligence to the manufacturers of other countries, the increased facilities of intercourse will result in transferring the demand from us to others;' and England's noblest Prince foresaw in International Exhibitions (which he was the first to inaugurate) the coming activity in things industrial; and in order to provide for the coming competition, he inaugurated, ere his lamented death, a system of industrial education." . . .

In France, Prussia, Saxony, and the small State of Wurtemberg, &c., trade schools, in addition to others of a higher class, are in existence, and furnish the connecting link between the man of science who discovers, and the superintendent who is the medium, and who, educated in these schools, aids by his instruction and advice, the workman in bringing into visible shape the discovery of the man of science, rendering practically useful that which existed as an idea only. If, then, industrial and technical training has benefited other countries and states, in their industrial progress (which no doubt it has), it becomes the duty of every Englishman to see to this important point.

It is impossible to go through the evidence of the eighty-six representatives of the skilled workmen of England, without sharing their profound conviction:—1st. Of the pressing peril of the nation in regard to manufacturing pre-eminence. 2d. Of the culpability of the educated classes and of the executive Government, in having neglected the education of the people. 3d. That it is satisfactorily proved by these reports, that the reluctance of the working classes to receive superior technical education, to bear taxation for that purpose, and to accept the active agency of Government institutions and officials, (which reluctance has been put forward as an excuse for this neglect), has no existence, in fact, and that it is therefore the negligence, apathy, and reluctance of the governing classes and the Government which have hitherto alone prevented the organization of systematic technical education. 4th. It appears that until the mission to France, of the English artisans in 1867, they, the working men of England,

were not aware that the Governments of other countries had organized complete education in all trade crafts, from the lowest mechanical labor to the highest professional skill. 5th. Throughout the whole of these reports there runs a feeling of profound admiration for the system of education given in France; but they were evidently not aware that the educated men and statesmen of France had themselves become conscious that their system was far below the level of excellence of the educated German nations; that a royal commission, under the presidency of M. Béhic, formerly Minister of Commerce, had recently been occupied with that subject, and had arrived at the conclusion that the technical education of France, which our artisans admired in Paris, was, as a national system of technical education, extremely defective; and the investigations of this Commission prove, that if England is the worst educated of the first-class Powers of Europe, France is the second worst. 6th. There runs parallel with these convictions a consciousness that the English workman, is, by nature, the best of workmen, and that with systematic education, their works would excel those of competing nations.

In conclusion, I have to state my deep conviction that the working men of England expect and demand of their Government the design, organization, and execution of systematic technical education, and there is urgent need for it to bestir itself, for other nations have already five-and-twenty years' start of us, and have produced one or two generations of educated workmen. Even if we begin to-morrow the technical education of all the youths of twelve years of age who have received sound elementary education, it will take seven years before these young men can commence the practical business of life, and then they will form but an insignificant minority in an uneducated mass. It will take fifteen years before those children who have not yet begun to receive an elementary education shall have passed from the age of 7 to 21, and represent a completely trained generation; and even then they will find less than half of their comrades educated. In the race of nations, therefore, we shall find it hard to overtake the five-and-twenty years we have lost. To-morrow, then, let us undertake, with all energy, our neglected task; the urgency is two-fold,—one half of our youth, let us say, has received elementary, but no technical education: for that half let us at once organize technical schools in every small town, technical colleges in every large town, and a technical university in the metropolis. The other half of the rising generation has received no education at all, and for them let us at once organize elementary education, even if compulsory.



## PUBLIC INSTRUCTION IN FRANCE.

### INTRODUCTION.

THE Empire of France, [exclusive of the colonies,] on an area of 206,676 English square miles in 1866, had a population of 38,067,094. In 1856, there were, among a total population of 36,012,669: 19,064,071 employed in agriculture, 10,469,961 in mechanical arts, and 1,632,331 in commercial pursuits.

The total expenditure in 1867 amounted to 1,902,111,370 francs, of which sum 28,344,121 francs were expended for public instruction under the following ministries, and with the following statistics:

#### FIRST.—UNDER THE MINISTRY OF PUBLIC INSTRUCTION:

##### 1. *Primary Instruction.*

53,957 Public Schools, in 37,548 Communes, with 2,461,492 pupils.

16,714 Private Elementary Schools, with 978,258 pupils.

3,669 Infant Schools, with 432,141 pupils.

32,383 Adult Courses, with 829,555 scholars.

*Total*, 106,723 Schools, with 4,701,446 scholars.

##### 2. *Secondary Instruction.*

83 Lyceums, with 36,306 students.

253 Communal Colleges, with 32,453 students—making a total of 336 government schools, with 68,759 students, of whom 17,209 follow the Special Secondary Course.

934 Non-governmental Secondary Schools, with 77,906 students.

*Total*, 1,270 Institutions, with 146,664 students.

##### 3. *Superior Instruction.*

8 Faculties or Schools of Theology, with 46 professors.

11 Faculties of Law, with 100 professors and 4,895 students.

16 Faculties of Science, with 119 professors.

16 Faculties of Literature, with 102 professors.

22 Preparatory Schools of Medicine and Pharmacy, with 190 professors.

3 Higher Schools of Medicine, with 66 professors and 1,780 students.

*Total*, 76 Institutions of the highest instruction, with 603 professors.

##### 4. *Special Schools.*

1 Normal School for Teachers in Infant Asylums at Paris.

1 Superior Normal School for Professors in Lyceums and the Faculties of Letters and Science at Paris, with 110 pupils and 23 professors.

1 Normal School for Secondary Special Instruction at Cluny.

84 Primary Normal Schools for male teachers, with 449 professors.

12 Primary Normal Schools for female teachers.

1 Primary Normal Course for male teachers, with 12 professors.

49 Primary Normal Courses for female teachers.

3 Schools of Living Oriental Tongues, with 9 professors.

1 Course of Archæology in connection with Cabinet of Medals.

1 French School of Archæology and Greek Literature at Athens.

1 Imperial School of Records (*ecole des chartes*) at Paris, to prepare pupils for librarians and keepers of public archives.

1 Museum of Natural History at Paris, with 16 professors.

1 School of Sacred Music at Paris.

1 Imperial College of France, with 31 professors.

## SPECIAL INSTRUCTION IN FRANCE.

- 1 Special School of Drawing for Young Women at Paris.
- 1 National Conservatory of Music at Paris : 87 professors.
- 6 Provincial Schools of Music : 6 professors, (at Dijon, Nantes, Metz, Lille, Toulouse, Marseilles.)
- 1 Institution for the Blind at Paris, besides 6 provincial schools.
- 2 National Institutions for Deaf-mutes at Paris and Bordeaux, besides 41 private and municipal schools.
- 1 Central Correctional House of Education at Paris.

### SECOND.—MINISTRY OF AGRICULTURE, COMMERCE, AND PUBLIC WORKS :

- 3 Imperial Schools of Agriculture at Grand-Jouan, Grignon, and La Saulsaie, with 24 professors.
- 9 Agricultural Courses, with 11 professors.
- 1 National Agronomic Institute at Versailles.
- 70 School-farms.
- 1 Practical School of Irrigation and Drainage at Lizardcau ; 2 professors.
- 1 National School of Horse-breeding.
- 3 Imperial Sheep-folds and Cow-houses (*bergeries and vacheries*.)
- 3 Schools of Veterinary Surgery at Alfort, Lyons, Toulouse, with 18 professors.
- 1 Superior School of Commerce at Paris ; 1 School of Chamber of Commerce at Paris.
- 1 Imperial School of Bridges and Roads at Paris ; 22 professors.
- 3 Imperial Schools of Mines, viz., at Paris, 15 professors ; at St. Etienne, 3 professors ; at Alais, 1 professor.
- 1 Imperial Conservatory of Arts and Industry at Paris ; 19 professors.
- 1 Central School of Arts and Manufactures at Paris ; 28 professors.
- 3 Imperial Schools of Arts and Industry, at Aix, Angers, Chalons-sur-Marne ; 32 professors.
- School of Watchmaking at Cluses (Savoy,) besides several provincial schools.

### THIRD.—MINISTRY OF WAR :

- 1 Imperial Polytechnic School at Paris ; 22 professors, 19 assistants, and 350 pupils.
- 1 Special Military School at St. Cyr ; 33 professors.
- 1 Staff-school (*ecole du corps d'etat-major*) at Paris ; 19 professors.
- 1 School of Artillery and Military Engineering [*ecole d'application de l'artillerie et du genie*] at Metz, with 28 professors.
- 1 Imperial School of Cavalry at Saumur ; 40 professors.
- 1 Cavalry-musicians' school [*ecole de trompettes*] at Saumur.
- 1 Imperial School of Military Medicine and Pharmacy at Paris ; 13 professors.
- 1 Imperial School for the Sanitary Service at Strasburg ; 12 professors.
- 1 Normal Shooting-school (*ecole normale de tir* ; ) 11 teachers.
- 1 Normal School of Military Gymnastics at Vincennes ; 3 teachers.
- 1 Imperial Prytaneum (orphans of officers) at La Flèche ; 25 professors.
- 11 Regimental Schools of Artillery.
- 3 Regimental Schools of Engineering.
- 5 Military Gymnasiums.
- 1 Military Musical Gymnasium at Paris.
- 1 Bureau of Longitudes ; 6 professors.
- 1 Imperial Observatory ; 18 professors, assistants and calculators.
- Regimental schools for the infantry of the line exist in all the corps.

### FOURTH.—MINISTRY OF MARINE AND THE COLONIES :

- 1 School of Naval Architecture at Paris, with 30 pupils ; 3 professors.
- 1 Practical School of Maritime Engineering at L'Orient ; 9 professors.
- 1 Imperial Naval School at Brest ; 11 professors.
- 42 National Schools of Hydrography ; 42 professors.
- 3 Imperial Schools of Naval Pharmacy and Medicine at Brest, Rochefort, and Toulon ; 15 professors.
- 6 Nautical School-ships ; 5 Naval Apprentice Schools ; 2 Schools for Naval Engineers and Stokers ; 2 Naval Drawing Schools.

### FIFTH.—MINISTRY OF FINANCE :

- 1 Imperial School of Forestry at Nancy ; 8 professors.
- 1 School of the Manufacture of Tobacco at Paris ; 7 professors.

### SIXTH.—MINISTRY OF THE FINE ARTS AND THE IMPERIAL HOUSEHOLD :

- 4 Imperial Schools of the Fine Arts ; at Paris, Rome, Lyons, and Dijon.
- 1 National Special School of Drawing and Mathematics applied to the Industrial Arts, at Paris.



## THE POLYTECHNIC SCHOOL AT PARIS.\*

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### I. FOUNDATION AND HISTORY.

THE origin of the *Ecole Polytechnique* dates from a period of disorder and distress in the history of France which might seem alien to all intellectual pursuits, if we did not remember that the general stimulus of a revolutionary period often acts powerfully upon thought and education. It is, perhaps, even more than the Institute, the chief scientific creation of the first French Revolution. It was during the government of the committee of public safety, when Carnot, as war minister, was gradually driving back the invading armies, and reorganizing victory out of defeat and confusion, that the first steps were taken for its establishment. A law, dating the 1st Ventose, year II., the 12th of March 1794, created a "Commission des Travaux Publics," charged with the duty of establishing a regular system for carrying on public works; and this commission ultimately founded a central school for public works, and drew up a plan for the competitive examination of candidates for admission to the service. It was intended at first to give a complete education for some of the public services, but it was soon changed into a preparatory school, to be succeeded by special schools of application. This was the *Ecole Polytechnique*.

The school and its plan were both owing to an immediate and pressing want. It was to be partly military and partly civil. Military, as well as civil education had been destroyed by the revolutionists. The committee of public safety had, indeed, formed a provisional school for engineers at Metz, to supply the immediate wants of the army on the frontier, and at this school young men were hastily taught the elements of fortification, and were sent direct to the troops, to learn as they best could, the practice of their art. "But such a method," says the report accompanying the law which founded the school, "does not form engineers *in any true sense of the term*, and can only be justified by the emergency of the

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\* Compiled from "*Report and Appendix of English Commissioners on Military Education.*" 1857.

time. The young men should be recalled to the new school to complete their studies." Indeed no one knew better than Carnot, to use the language of the report, "that patriotism and courage can not "always supply the want of knowledge;" and in the critical campaigns of 1793—4, he must often have felt the need of the institution which he was then contributing to set on foot. Such was the immediate motive for the creation of this school. At first, it only included the engineers amongst its pupils. But the artillery were added within a year.

We must not, however, omit to notice its civil character, the combination of which with its military object forms its peculiar feature, and has greatly contributed to its reputation. Amongst its founders were men, who though ardent revolutionists, were thirsting for the restoration of schools and learning, which for a time had been totally extinguished. The chief of these, besides Carnot, were Monge and Fourcroy, Berthollet and Lagrange. Of Carnot and Lagrange, one amongst the first of war ministers, the other one of the greatest of mathematicians, we need not say more. Berthollet, a man of science and practical skill, first suggested the school; Monge, the founder of Descriptive Geometry, a favorite *savant* of Napoleon though a zealous republican, united to real genius that passion for teaching and for his pupils, which makes the *beau idéal* of the founder of a school; and Fourcroy was a man of equal practical tact and science, who at the time had great influence with the convention, and was afterwards intrusted by Napoleon with much of the reorganization of education in France.

When the school first started there was scarcely another of any description in the country. For nearly three years the revolution had destroyed every kind of teaching. The attack upon the old schools, in France, as elsewhere, chiefly in the hands of the clergy, had been begun by a famous report of Talleyrand's, presented to the legislative assembly in 1791, which recommended to suppress all the existing academies within Paris and the provinces, and to replace them by an entirely new system of national education through the country. In this plan a considerable number of military schools were proposed, where boys were to be educated from a very early age. When the violent revolutionists were in power, they adopted the destructive part of Talleyrand's suggestions without the other. All schools, from the university downwards, were destroyed; the large exhibitions or *Bourses*, numbering nearly 40,000, were confiscated or plundered by individuals, and even the military schools and those for the public works (which were abso-



lutely necessary for the very roads and the defense of the country) were suppressed or disorganized. The school of engineers at Mézières (an excellent one, where Monge had been a professor,) and that of the artillery at La Fère, were both broken up, whilst the murder of Lavoisier, and the well known saying in respect to it, that "the Republic had no need of chemists," gave currency to a belief, which Fourcroy expressed in proposing the Polytechnic, "that the late conspirators had formed a deliberate plan to destroy the arts and sciences, and to establish their tyranny on the ruins of human reason."

Thus it was on the ruin of all the old teaching, that the new institution was erected; a truly *revolutionary* school, as its founders delighted to call it, using the term as it was then commonly used, as a synonym for all that was excellent. And then for the first time avowing the principle of public competition, its founders, Monge and Fourcroy, began their work with an energy and enthusiasm which they seem to have left as a traditional inheritance to their school. It is curious to see the difficulties which the bankruptcy of the country threw in their way, and the vigor with which, assisted by the summary powers of the republican government, they overcame them. They begged the old Palais Bourbon for their building; were supplied with pictures from the Louvre; the fortunate capture of an English ship gave them some uncut diamonds for their first experiments; presents of military instruments were sent from the arsenals of Havre; and even the hospitals contributed some chemical substances. In fine, having set their school in motion, the government and its professors worked at it with such zeal and effect, that within five months after their project was announced, they had held their first entrance examination, open to the competition of all France, and started with three hundred and seventy-nine pupils.

The account of one of these first pupils, who is among the most distinguished still surviving ornaments of the Polytechnic, will convey a far better idea of the spirit of the young institution than could be given by a more lengthy description. M. Biot described to us vividly the zeal of the earliest teachers, and the thirst for knowledge which, repressed for awhile by the horrors of the period, burst forth with fresh ardor amongst the French youth of the time. Many of them, he said, like himself, had been carried away by the enthusiasm of the revolution, and had entered the army. "My father had sent me," he added, "to a mercantile house, and indeed I never felt any great vocation to be a soldier, but *Que voulez vous?*"



*les Prussiens etaient en Champagne.*" He joined the army, served two years under Dumouriez, and returned to Paris in the reign of terror, "to see from his lodgings in the Rue St. Honore the very generals who had led us to victory, Custine and Biron, carried by in the carts to the guillotine. "Imagine what it was when we heard that Robespierre was dead, and that we might return safely to study after all this misery, and then to have for our teachers La Place, Lagrange, and Monge. We felt like men brought to life again after suffocation. Lagrange said, modestly, "Let me teach them arithmetic." Monge was more like our father than our teacher; he would come to us in the evening, and assist us in our work till midnight, and when he explained a difficulty to one of our *chefs de brigade*, it ran like an electric spark through the party." The pupils were not then, he told us, as they have since been, shut up in barracks, they were left free, but there was no idleness or dissipation amongst them. They were united in zealous work and in good *camaraderie*, and any one known as a bad character was avoided. This account may be a little tinged by enthusiastic recollections, but it agreed almost entirely with that of M. de Barante, who bore similar testimony to the early devotion of the pupils, and the unique excellence of the teaching of Monge.

We are not, however, writing a history of this school, and must confine ourselves to such points as directly illustrate its system of teaching and its organization. These may be roughly enumerated in the following order :

1. Its early history is completed by the law of its organization, given it by La Place in his short ministry of the interior. This occurred in the last month of 1799, a memorable era in French history, for it was immediately after the revolution of the 18th of Brumaire, when Napoleon overthrew the Directory and made himself First Consul. One of his earliest acts was to sign the charter of his great civil and military school. This charter or decree deserves some attention, because it is always referred to as the law of the foundation of the school. It determined the composition of the two councils of instruction and improvement, the bodies to which the direction of the school was to be, and still is, intrusted; some of its marked peculiarities in the mode and subject of teaching. It is important to notice each of the two points.

The direction of the school was at first almost entirely in the hands of its professors, who formed what is still called its Council of Instruction. Each of them presided over the school alternately for one month, a plan copied from the revolutionary government of



the Convention. In the course of a few years, however, another body was added, which has now the real management of the school. This is called the "Council of Improvement" (*Conseil de perfectionnement*), and a part of its business is to see that the studies form a good preparation for those of the more special schools (*écoles d'application*) for the civil and military service. It consists of eminent men belonging to the various public departments supplied by the school, and some of the professors. It has had, as far as we could judge, an useful influence; *first*, as a body not liable to be prejudiced in its proposals by the feelings of the school, and yet interested in its welfare and understanding it; *secondly*, as having shown much skill in the difficult task of making the theoretical teaching of the Polytechnic a good introduction to the practical studies of the public service; *thirdly*, as being sufficiently influential, from the character of its members, to shield the school from occasional ill-judged interference. It should be added that hardly any year has passed without the Council making a full report on the studies of the school, with particular reference to their bearing on the Special Schools of Application.

The method of scientific teaching has been peculiar from the beginning. It is the most energetic form of what may be called the *repetitorial* system, a method of teaching almost peculiar to France, and which may be described as a very able combination of professional and tutorial teaching. The object of the *répétiteur*, or private tutor, is to second every lecture of the professor, to explain and fix it by ocular demonstration, explanations, or examination. This was a peculiarity in the scheme of Monge and Fourcroy. The latter said, in the first programme, "Our pupils must not only learn, they must at once carry out their theory. We must distribute them into small rooms, where they shall practice the plans of descriptive geometry, which the professors have just shown them in their public lectures. And in the same manner they must go over in practice (*répéteront*) in separate laboratories the principal operations of chemistry." To carry out this system the twenty best pupils, of whom M. Biot was one, were selected as *répétiteurs* soon after the school had started. Since then the vacancies have always been filled by young but competent men, aspiring themselves to become in turn professors. They form a class of teachers more like the highest style of private tutors in our universities, or what are called in Germany *Privat-docenten*, than any other body—with this difference, that they do not give their own lectures, but breaking up the professor's large class into small classes of five and six pupils, exam-

ine these in *his* lecture. The success of this attempt we shall describe hereafter.

2. A change may be noticed which was effected very early by the Council of Improvement—the union of pupils for artillery and engineers in a single school of application. The first report in December 1800, speaks of the identity in extent and character of the studies required for these two services; and in conformity with its recommendation, the law of the 3rd of October 1802, (12th Vendémiaire, XI.) dissolved the separate artillery school at Châlons, and established the united school for both arms in the form which it still retains at Metz.

3. In 1805 a curious change was made, and one very characteristic of the school. The pupils have always been somewhat turbulent, and generally on the side of opposition. In the earliest times they were constantly charged with *incivisme*, and the aristocracy was said to have “taken refuge within its walls.” In fact, one of its earliest and of its few great *literary* pupils, M. de Barante, confirmed this statement, adding, as a reason, that the school gave for a while the only good instruction in France. It was in consequence of some of these changes that the pupils who had hitherto lived in their own private houses or lodgings in Paris, were collected in the school building. This “*casernement*,” said to be immediately owing to a burst of anger of Napoleon, naturally tended to give the school a more military character; but it was regarded as an unfortunate change by its chief scientific friends. “*Ah! ma pauvre école!*” M. Biot told us he had exclaimed, when he saw their knapsacks on their beds. He felt, he said, that the enthusiasm of free study was gone, and that now they would chiefly work by routine and compulsion.

4. The year 1809 may be called the epoch at which the school attained its final character. By this time the functions, both of boards and teachers, were accurately fixed, some alterations in the studies had taken place, and the plan of a final examination had been drawn up, according to which the pupils were to obtain their choice of the branch of the public service they preferred. In fact, the school may be said to have preserved ever since the form it then assumed, under a variety of governments and through various revolutions, in most of which, indeed, its pupils have borne some share; and one of which, the restoration of 1816, was attended with its temporary dissolution.

Thus, during the first years after its foundation the Polytechnic grew and flourished in the general dearth of public teaching, being



indeed not merely the only great school, but, until the Institute was founded, the only scientific body in France. Working on its first idea of high professorial lectures, practically applied and explained by *répétiteurs*, its success in its own purely scientific line was, and has continued to be, astonishing. Out of its sixteen earliest professors, ten still retain an European name. Lagrange, Monge, Fourcroy, La Place, Guyton de Morveau were connected with it. Malus, Haüy, Biot, Poisson, and De Barante, were among its earliest pupils. Arago, Cauchy, Cavaignac, Lamoricière, with many more modern names, came later. All the great engineers and artillerymen of the empire belonged to it, and the long pages in its calendar of distinguished men are the measure of its influence on the civil and military services of France. In fact its pupils, at a time of enormous demands, supplied all the scientific offices of the army, and directed all the chief public works, fortresses, arsenals, the improvement of cities, the great lines of roads, shipbuilding, mining—carried out, in a word, most of the great improvements of Napoleon. He knew the value of his school, “the hen” as he called it, “that laid him golden eggs”—and perhaps its young pupils were not improved by the excessive official patronage bestowed by him upon “the envy of Europe,” “the first school in the world.” It can not, however, be matter of surprise, that its vigor and success should have caused Frenchmen, even those who criticise its influence severely, to regard it with pride as an institution unrivaled for scientific purposes.

It is not necessary to give any detailed account of the later history of the school, but we must remark that disputes have frequently arisen with regard to the best mode of harmonizing its teaching with that of the special schools of application to which it conducts. These disputes have been no doubt increased by the union of a civil and military object in the same school. The scientific teaching desirable for some of the higher civil professions has appeared of doubtful advantage to those destined for the more practical work of war. There has been always a desire on the one side to qualify pure mathematics by application, a strong feeling on the other that mathematical study sharpens the mind most keenly for some of the practical pursuits of after life. We should add, perhaps, that there has been some protest in France (though little heard among the scientific men who have been the chief directors of the school) against the *esprit faux*, the exclusive pursuit of mathematics to the utter neglect of literature, and the indifference to moral and historical studies. Some one or other of these com-

plaints any one who studies the *literature*, the pamphlets, and history of the school will find often reproduced in the letters of war ministers, of artillery and engineer officers commanding the school of application at Metz, or of committees from the similar schools for the mines and the roads and bridges. The last of these occasions illustrates the present position of the school.

On the 5th of June 1850, the legislative assembly appointed a mixed commission of military men and civilians, who were charged to revise all the programs of instruction, and to recommend all needful changes in the studies of the pupils, both those preparatory to entrance\* and those actually pursued in the school. The commission was composed as follows:—

M. Thenard. Member of the Academy of Sciences, and of the Board of Improvement of the Polytechnic School, President.

Le Verrier, Member of the Academy of Sciences and of the Legislative Assembly, Reporter.

Noizet, General of Brigade of Engineers.

Poncelet, General of Brigade of Engineers, Commandant of the Polytechnic School, Member of the Academy of Sciences.

Piobert, General of Brigade of Artillery, Member of the Academy of Sciences. Mathieu, Rear Admiral.

Duhamel, Member of the Academy of Sciences, Director of Studies at the Polytechnic School.

Mary, Divisional Inspector of Roads and Bridges.

Morin, Colonel of Artillery, Member of the Academy of Sciences.

Regnault, Engineer of Mines, Member of the Academy of Sciences.

Olivier, Professor at the *Conservatoire des Arts et Metiers*.

Debacq, Secretary for Military Schools at the Ministry of War, Secretary.

A chronic dispute which has gone on from the very first year of the school's existence, between the exclusive study of abstract mathematics on the one hand, and their early practical application on the other, was brought to a head (though it has scarcely been set at rest) by this commission. All the alterations effected have been in the direction of eliminating a portion of the pure mathematics, and of reducing abstract study to the limits within which it was believed to be most directly applicable to practice. The results, however, are still a subject of vehement dispute, in which most of the old scientific pupils of the Polytechnic, and many of what may be styled its most practical members, the officers of the artillery and engineers, are ranged on the side of "early and deep scientific study *versus* early practical applications." It is, indeed, a question which touches the military pupils nearly, since it is in their case particularly that the proposed abstract studies of the Polytechnic might be thought of the most doubtful advantage. We do not try to solve the problem here, though the facts elsewhere stated will afford some materials for judgment. We incline to the opin-

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\* In an Analysis of the Report of this Commission, see page .



ion of those who think that the ancient *genius loci*, the traditional teaching of the school, will be too strong for legislative interference, and that, in spite of recent enactments, abstract science and analysis will reign in the lecture-rooms and halls of study of the Polytechnic, now as in the days of Monge.

## II. AN OUTLINE OF THE MANAGEMENT AND OF THE ESTABLISHMENT OF THE SCHOOL, ETC.

The Polytechnic, as we have said, is a preparatory and general scientific school; its studies are not exclusively adapted for any one of the departments to which at the close of its course the scholars will find themselves assigned; and on quitting it they have, before entering on the actual discharge of their duties of whatever kind, to pass through a further term of teaching in some one of the schools of application specially devoted to particular professions.

The public services for which it thus gives a general preparation are the following:

### *Military: Under the Minister at War.*

Artillery (*Artillerie de terre.*)  
 Engineers (*Génie.*)  
 The Staff Corps (*Corps d'Etat Major.*)  
 The Department of Powder and Saltpetre (*Poudres et Salpêtres.*)

### *Under the Minister of Marine.*

Navy, (*Marine.*)  
 Marine Artillery (*Artillerie de mer.*)  
 Naval Architects (*Génie maritime.*)  
 The Hydrographical Department (*Corps des Ingénieurs Hydrographes.*)

### *Civil: Under the Minister of Public Works.*

The Department of Roads and Bridges (*Ponts-et-chaussées.*)  
 The Department of Mines (*Mines.*)

### *Under the Minister of the Interior.*

The Telegraph Department (*Lignes Télégraphiques.*)

### *Under the minister of Finance.*

The Tobacco Department (*Administration des Tabacs.*)

To these may be added at any time, by a decree on the part of the government, any other departments, the duties of which appear to require an extensive knowledge of mathematics, physics, or chemistry.

Admission to the school is, and has been since its first commencement in 1794, obtained by competition in a general examination, held yearly, and open to all. Every French youth, between the age of sixteen and twenty, (or if in the army up to the age of twenty five,) may offer himself as a candidate.

A board of examiners passes through France once every year, and examines all who present themselves, that have complied with the conditions, which are fully detailed in the decree given in the appendix. It commences at Paris.

A list of such of the candidates as are found eligible for admittance to the Polytechnic is drawn up from the proceedings of the board, and submitted to the minister at war; the number of places likely to be vacant has already been determined, and the minister fixes the number of admissions accordingly. The candidates admitted are invariably taken in the order of merit.

The annual charge for board and instruction is 40*l.* (1,000 fr.) payable in advance in four installments. In addition there is the cost of outfit, varying from 20*l.* to 24*l.* Exhibitions, however, for the discharge of the whole or of one-half of the expense (*bourses* and *demi-bourses*), are awarded by the state in favor of *all* the successful candidates, whose parents can prove themselves to be too poor to maintain their children in the school. Outfits and half outfits (*trousseaux*) and *demi-trousseaux*) are also granted in these cases, on the entrance of the student into the school; and the number of these *boursiers* and *demi-boursiers* amounts at the present time to one-third of the whole.

The course of study is completed in two years. On its successful termination which is preceded by a final examination, the students are distributed into the different services, the choice being offered them in the order of their merit, and laid down in the classified list drawn up after the examination. If it so happen that the number of places or the services which can be offered is not sufficient for the number of qualified students, those at the bottom of the list are offered service in the infantry or cavalry, and those who do not enter the public service, are supplied with certificates of having passed successfully through the school. Students who have been admitted into the school from the army, are obliged to re-enter the army.

All others, as has been said, have the right of choosing, according to their position on the list, the service which they prefer, so far, that is, as the number of vacancies in that service will allow; or they may if they please decline to enter the public service at all.

Such is a general outline of the plan and object of the school. We may add that, besides its military staff, it employs no less than thirty-nine professors and teachers; that it has four boards of management, and that ten scientific men unconnected with the school, and amongst the most distinguished in France, conduct its examina-



tions. The magnitude of this establishment for teaching may be estimated by the fact, that the number of pupils rarely exceeds three hundred and fifty, and is often much less.

A fuller enumeration of these bodies will complete our present sketch.

### I. The military establishment consists of:—

The Commandant, a General Officer, usually of the Artillery or the Engineers, at present a General of Artillery.

A Second in Command, a Colonel or Lieutenant-Colonel, chosen from former pupils of school; at present a Colonel of Engineers.

Three Captains of Artillery and Three Captains of Engineers, as Inspectors of Studies, chosen also from former pupils of the school.

Six Adjutants (*adjoints*), non-commissioned officers, usually such as have been recommended for promotion.

### II. The civil establishment consists of:—

1. A Director of Studies, who has generally been a civilian, but is at present a Lieutenant-Colonel of Engineers.

2. Fifteen Professors, viz.:—Two of Mathematical Analysis. Two of Mechanics and Machinery. One of Descriptive Geometry. Two of Physics. Two of Chemistry. One of Military Art and Fortification. One of Geodesy. One of Architecture. One of French Composition. One of German. One of Drawing. Of these one is an officer of the Staff, another of the Artillery, and a third of the Navy; two are Engineers in Chief of the Roads and Bridges; nine are civilians, of whom two are Members of the Academy of Sciences.

3. Three Drawing Masters for Landscape and Figure Drawing; one for Machine Drawing, and one for Topographical Drawing.

4. Nineteen Assistant and Extra Assistant Teachers, (*répétiteurs* and *répétiteurs adjoints*) whose name and functions are both peculiar.

5. Five Examiners for Admission, consisting at present of one Colonel of Artillery, as President, and four civilians.

6. Five Examiners of Students (civilians,) four of them belonging to the Academy of Sciences.

7. There is also a separate Department for the ordinary Management of Administration of the affairs of the school, the charge of the fabric and of the library and museums; and a Medical Staff.

III. The general control or supervision of the school is vested, under the war department, in four great boards of councils, viz.:—

1. A board of administration, composed of the commandant, the second in command, the director of studies, two professors, two captains, and two members of the administrative staff. This board has the superintendence of all the financial business and all the minutiae of the internal administration of the school.

2. A board of discipline, consisting of the second in command, the director, two professors, three captains (of the school,) and two captains of the army, chosen from former pupils. The duty of this board is to decide upon cases of misconduct.

3. A board of instruction, whose members are, the commandant, the second in command, the director, the examiners of students, and the professors; and whose chief duty is to make recommendations relating to ameliorations in the studies, the programmes of admission and of instruction in the school, to—

4. A board of improvement, charged with the general control of the studies, and composed of the commandant and second in command, the director of studies, a delegate from each department of the public service for which the school prepares its pupils, three of the examiners of the school, three members of the Academy of Sciences, and three professors of the school.

### III. THE ENTRANCE EXAMINATION.

Admission is by open competitive examination, held annually by persons appointed by the Minister of War on the recommendation of the Board of Instruction. Candidates must be (1) French born, or naturalized citizens; (2) at least sixteen and not over twenty years of age, except in the case of actual service in the army, when the age is extended to twenty-five; (3) must be bachelors of science or letters, or have completed the equivalent of the lyceum course.

The subjects of this examination are, arithmetic, algebra, geometry, trigonometry, mechanics, natural philosophy, elements of chemistry and drawing, and one of four modern languages: German, English, Italian, Spanish, and Arabic, and a knowledge will count.

The examination is partly written and partly oral, and is both preliminary and formal. The first is to ascertain the health, vigor, general aptitude, and knowledge of the candidate. In this examination each candidate must hand in certain written sheets containing calculations, sketches, plans and drawings, executed by him at school during the year, certified and dated by the professor under whom he has studied. If these papers are found not to be the work of the pupil, or are not satisfactory, he is excluded at once from the competition.

The written examination occupies about twenty-four hours, distributed through four separate days, and is conducted in the presence of certain official authorities, and in the absence of the examiners, who mark the papers on a certain scale of merit. Each candidate is examined orally for three-quarters of an hour upon each of two successive days, by each of two examiners separately; and the results are then compared with the written examination, and if the examiners differ in their estimate of a candidate's work, he is entitled to a second oral examination. The marks of the examiners are then communicated to the commandant, who makes out a classified list, which, with all the papers respecting each candidate, is then submitted to a jury, who, after a scrutiny of all the documents, submit a corrected list to the Minister of War, who can add a certain number for special reasons, and the candidates are then admitted to the school in the order of the list.

### IV. SUBJECTS AND COURSES OF INSTRUCTION.

Although slight changes are made in the order and time assigned to the several subjects, the following account given by Prof. Bache, with the modifications of 1856, is substantially correct for 1869.



## ANALYSIS.

*First Year.* Differential and integral calculus, to include the rectification and quadrature of plane curves, and curved surfaces, and the cubature of solids.

*Second Year.* Differential and integral calculus continued. Elements of the calculus of variations and of finite differences. Formulæ of interpolation, &c.

## MECHANICS.

*First Year.* Statics.—Composition and equilibrium of forces. Theory of parallel forces. Of the center of gravity. Attraction of a point by a homogenous sphere. Dynamics.—General formation of motion. The pendulum. Projectiles. Problems in physical astronomy.

*Second Year.* Statics continued. Forces applied to an invariable system. Principle of virtual velocities. Application to simple mechanics. Dynamics. D'Alembert's principle. Collision. Moment of inertia, &c. Hydrostatics. Hydrodynamics.

Every lecture of analysis or mechanics is preceded or followed by interrogations by the professor. Problems are given out for solution. The repeaters interrogate the pupils three times per week. After the completion of the course, general interrogations take place, upon the whole subject, by the professors and repeaters.

## DESCRIPTIVE GEOMETRY.

Problems relating to the right line and plane (twelve problems.) Tangent planes and normals to curved surfaces (four problems.) Intersections of surfaces (seven problems.) Miscellaneous problems (seven.)

*Applications of Descriptive Geometry.* Problems with a single plane of projection, and a scale of declivity. Linear perspective (three problems.) Shadows (three problems.) Stone cutting (seven problems.) Carpentry (four problems.)

*India-ink drawing.* Elements in four examples.

## ANALYTICAL GEOMETRY.

The right line and plane. Curved surfaces.

The professor may precede or follow his lecture by interrogations. During the course the class is examined by the repeaters, and at the close of the studies of Analytical Geometry there is a general review.

## MACHINES, ASTRONOMY, GEODESY, AND SOCIAL ARITHMETIC.

Elements of Machines. Machines for transporting burthens and for pressure. For raising liquids. Moved by air, by water, by steam. Useful effect of machines.

*Astronomy and Geodesy.* Formulæ of spherical trigonometry. Measurement of space and time. Of the celestial bodies. Of the earth. Elements of physical geography and hydrography. Geodesy. Instruments. Figures of the earth. Projection of maps and charts.

Elements of the calculation of probabilities. Tables. Insurances. Life insurance, &c.

Interrogations by the professor accompany the lessons. Those by the repeater must be at least as frequent as those by the professor. At the close of the principal courses there is a general review, in the way of interrogation, by the professor and repeater.

## PHYSICS.

*First Year.* 1. General properties of bodies. Falling bodies. Principle of equilibrium of fluids. Specific gravities. 2. Heat. Radiation, conduction, &c. Vapors. Latent heat. 3. General constitution of the atmosphere. Hygrometry. 4. Molecular attraction. Capillary action. 5. Electricity. Laws of attraction, repulsion, distribution, &c. Atmospheric electricity. Modes of developing electricity.

*Second Year.* 6. Magnetism. Phenomena and laws of magnetism. Instruments. Reciprocal action of magnets and electrical currents. Electro-dynamics. Mutual actions of electrical currents. Thermo-electric phenomena. 7. Acoustics. Of the production, propagation, velocity, &c., of sound. Acoustic instruments. 8. Optics. Mathematical and physical optics. Optical instruments.

During the whole course the repeaters interrogate each division twice every week: they go through the study-rooms, and give any explanations which may be required by the pupils

## CHEMISTRY.

*First Year.* General principles. Division of the course. Examination of the principal simple substances. Mixtures and binary compounds. Laws of definite proportions, &c. Hydracids. Oxacids and oxides. Bases. Neutral binary compounds. Salts. Principal metals.

*Second Year.* Reciprocal action of acids and oxides. Action of water upon salts. Laws of Berthollet discussed. General properties of the carbonates, and special study of some of the more important. Borates and silicates. Glass and pottery. Nitrates. Gunpowder. Phosphates, &c. Sulphates. Chlorates. Chromates and other classes of salts, with details as to the more important. Extraction of the metals from their ores, methods of refining, &c. Organic chemistry. Vegetable substances. Animal substances.

This course is accompanied by manipulations in the laboratory of the institution, in which the most useful preparations of the course are made by the pupils themselves. They are also taught the principles of analysis, both mineral and organic, practically.

## ARCHITECTURE.

Component parts of edifices. General principles. Materials. Foundations. Strength. Forms and proportions of the parts of buildings. Floors. Roofs, arches, &c. General principles of the compositions of parts of edifices. Illustrations of the different varieties of parts, as porticos, porches, vestibules, halls, &c. Composition of an edifice. Varieties of buildings—as colleges, hospitals, prisons, barracks, &c.

The pupils copy from the board the sketches of the professor, and draw them carefully when required. At the close of the lectures there are four different subjects assigned, upon each of which there is a competition. The pupils are classified according to the result of these competitions, and of the marks for their graphic exercises during the course. The best



designs are exhibited. Three India-ink drawings are made on architectural subjects during this course.

#### FRENCH COMPOSITION.

The course consists principally in the writing of essays and compositions by the pupils, which are subsequently criticised during the recitations.

#### GERMAN LANGUAGE.

Elements of the language. Grammar reading. Themes and versions. Every lecture is followed by an examination of an hour and a-half in duration, by the professor or repeater. There are, besides, exercises of pronunciation and common conversation.

#### TOPOGRAPHY.

Exercises in topographical drawing. Different modes of representing the ground by horizontal curves, the projections of lines of greatest declivity, and by shading. Conventional signs. Lettering. The exercises of the second division are preceded by lessons from the professor of geodesy, explanatory of the theory.

#### DRAWING OF THE HUMAN FIGURE AND LANDSCAPE DRAWING.

In the first branch the pupils are divided into two classes, one of which copies engravings, and the other draws from models. On entering the school the pupils are classified according to the drawings which they made at the examination for admission. They are then divided into two sections, of as nearly equal strength as possible, and assigned, each one, to a master, with whom they remain during their course. One of the drawing-masters is specially charged with the course of drawing from casts and from nature. At the beginning of the second year, the highest third of the pupils of each section of the former first division go to the teacher of drawing in water colors, and remain for two months. They return to their sections, and are replaced by the next division, each pupil occupying a third of the second year in this kind of drawing. The merits of the drawings are judged every two months. After the first of May the ordinary drawing lessons are replaced by those in water colors.

Besides these regular studies, there are from twelve to fifteen lectures on anatomy and physiology, given towards the close of the second year, during hours not devoted to the regular branches, and which it is optional with the pupils to attend or not. Fencing, music, and dancing lessons, are also given.

During the interrogations by the professors and repeaters, notes are taken of the merit of the answers of the pupils, according to a uniform scale of marks. These are communicated with the subjects of each lecture or recitation to the director of studies, and placed upon record, as assisting in determining the merit of the pupils. The examiners mark according to the same scale. The pupils are classified after the examinations in the several departments, and in taking the average for the standing in general merit, a different weight is allowed to the different courses. Mathematics counts most, and then the graphic exercises, descriptive geometry and geodesy united, and conduct count the same—then physics and chemistry.

The examinations at the end of the two years of study are divided into four; the first, on the courses of the first year, including analysis, part of analytical geometry, and mechanics; the second, on chemistry; the third, on physics; the fourth, on descriptive geometry and its applications, and part of analytical geometry. The examination at the close of the second year is divided as follows:—First, analysis, analytical geometry, mechanics, effects of machines and social arithmetic. Second, chemistry. Third, physics. Fourth, geodesy, description of machines, and architecture. The examination on analysis and its applications, and mechanics, are conducted by the two permanent examiners. The pupils are examined singly and without the presence of their comrades, and each examiner occupies a separate room. Where the branches admit of it, the examinations are viva voce, the student using the blackboard when required.

After the examinations are completed, the results are reported to a board, who, with all the materials before them from the examiners and from the school, decide whether the pupils may pass to the higher division, or are admissible into the public service, according to the division to which they belong. This board ("jury") consists of the two commandants, the director of studies, the two permanent and three temporary examiners.

The arrangement of the time allotted to study, like the similar points in regard to instruction, is a matter of very minute regulation. The pupils study in large rooms, conveniently fitted up for the purpose, and where they receive by lot, at entrance, places which they retain, in general, during the course. The interrogations or recitations take place in rooms adapted to that purpose, separate from the larger lecture halls. These recitation-rooms are also open to the pupils in winter, during recreation hours, and after supper; and in summer, whenever the weather is bad, so as to prevent them from spending the time in the open air, besides at certain stated periods before the examinations. The repeaters are present during



the periods devoted to the studies of their several departments, and, except in the cases of the graphic exercises where it is not allowed, are expected to give assistance to the pupils who ask for it.

The order of the day in the institution is arranged with a view to bring the lectures, recitations, and studies of particular branches together. Besides this, there are study-hours called free, in which the student may employ himself as he pleases, otherwise than in drawing of any kind (graphic exercises.)

The discipline of the school is thoroughly military, and the means of carrying it out in all its strictness are provided. The regulations are very minute, and fix, in detail, the punishment considered equivalent to each offense, as well for those against morals as transgressions of the regulations themselves. The punishments are—1. Private admonition by the commandant or vice-commandant. 2. Public reprimand before the corps of pupils. 3. Confinement to the walls of the institution, or stoppage of leave. 4. Confinement to the house. 5. Imprisonment within the walls. 6. Military imprisonment. 7. Dismission. The usual punishment for trivial offenses is the stoppage ("sortie,") one of which is equivalent to a deprivation of the general leave of absence for half a day. This may be awarded by an officer as low as an adjutant. It follows certain specified offenses, as overstaying a leave, when the number of stoppages is in proportion to the time of overstaying the leave, and is even assigned for a failure in recitation. Imprisonment within the walls can only be awarded by the commandant, vice-commandant, or director of studies, and excludes the student from the recitation-room. Confinement in the military prison requires the order of the commandant, who reports the case at once to the minister of war. Dismission can not take place without the sanction of the minister. Cases of discipline, suppose to involve dismission or the loss of a bursary, are referred to a board called the council of discipline, and composed of the two commandants, the director of studies, two professors, two captain inspectors, the captain instructor, and one administrator.

For military exercises, and the general furtherance of discipline, the pupils form a battalion, divided into four companies, each division of the school forming two companies. From each company eight petty officers, called sergeants, are taken according to the order of the merit-roll of the division, making thirty-two in the whole battalion. These sergeants are distinguished by appropriate military badges. The sergeants have charge of the other pupils in the study-rooms, halls, recitation-rooms, refectory, laboratories, and lecture-rooms, and two of them in turn are joined with a higher officer, an adjutant, in the inspection of the food. They have charge in general of the details of police. The second sergeants are intrusted with the collection of money due by their comrades for letters and other authorized expenses. These officers are appointed once a year.

The administration of the fiscal affairs of the school is committed to a board consisting of the commandant and vice-commandant, the director of studies, two professors, designated by the council of instruction, two inspectors of studies in turn, according to rank, the administrator or steward as reporter (rapporteur,) the treasurer as secretary. The last two named agents are consulting members only. This board meets twice every month. It prepares the estimates for the expenses of the school, which are submitted to the minister of war. The form of these and, indeed, of all the accounts, is laid down minutely in regulations.

The payment made by parents for the maintenance of the pupils does not go into the treasury of the institution, but into the general central treasury of the country. The school furnishes the pupil, for a stipulated sum, with his board, lodging, clothing, and petty expenses. For repairs of clothing and petty expenses, a special sum is set aside, of which the student receives an account. Parts of the supply of clothing, &c., at entrance, may be furnished by the parents, but the rest is supplied by the school at the parents' expense.

The steward (administrateur) is the executive officer of the domestic economy of the school—prepares all matters of business for the consideration of the council of administration, and the estimates of every kind, regular and contingent; presents the plans and estimates of the architect of the school for repairs or new buildings, and superintends their execution when authorized; makes contracts and receives the articles contracted for; has charge of the issue of all articles, of the store-houses, and of the servants; superintends the infirmary; he nominates the subordinate persons employed in his department, and is responsible directly to the council, in virtue of the authority of which he is supposed to act.



Since the date of Prof. Bache's Report, the administration, the entrance examination, and course of instruction in the Polytechnic school has undergone some changes, and yet the main purpose, features, and methods of the institution, remain the same, winning from the Commission appointed by the War Department of the British Government in 1856, "to consider the best mode of reorganizing the system of training officers for the Scientific Corps" of the Army, the following testimony.

Regarded simply as a great mathematical and scientific school, its results in producing eminent men of science have been extraordinary. It has been the great (and a truly great) Mathematical University of France.

Regarded again as a preparatory school for the public works, it has given a very high scientific education to civil engineers, whose scientific education in other countries (and amongst ourselves) is believed to be much slighter and more accidental.

Regarded as a school for the scientific corps of the Army, its peculiar mode of uniting in one course of competition candidates for civil and military services, has probably raised scientific thought to a higher point in the French than in any other army.

Regarded as a system of teaching, the method it pursues in developing the talents of its pupils appears to us the best we have ever studied.

It is in its studies and some of its main principles that the example of the polytechnic school may be of most value. In forming or improving any military school, we can not shut our eyes to the successful working at the polytechnic of the principle, which it was the first of all schools to initiate, the making great public prizes the reward and stimulus of the pupil's exertions. We may observe how the state has here encouraged talent by bestowing so largely assistance upon all successful, but poor pupils, during their school career.

The commission in the course of their report, mention a few "marked defects." "Such is the attempt to give exactly the same teaching, lesson by lesson, during a course of two years, to a class of one hundred and sixty pupils, with no reference to their varieties of ability, or power of application. This practice has a tendency either to make many of the pupils superficial, or to exhaust them." "Another defect is the exclusively mathematical spirit encouraged and its tendency to prevent the education (of officers both civil and military) from being truly liberal." "Nor can we avoid remarking that education has its moral as well as its merely intellectual side, and we were not merely as much impressed with the moral and manly, as by the intellectual effects of the Polytechnic teaching." "In spite of these drawbacks, many points in its system of teaching is admirable; and it does for the Army, and the services of the Public Works of France, what the Universities do chiefly for the Bar and Clerical Profession in England."

We append a note by Prof. Gillespie.



## NOTE.

We add a very condensed synopsis of the subjects embraced in the "*Interior Instruction*" of the Polytechnic School in 1856. The reasonings which led the Commission to select these special subjects, and to proportion them as here shown, may be given hereafter. The numbers in parentheses, which follow the topics, indicate how many lectures are given to them. Each lecture embraces one and a half hours, of which the first half-hour, *at least*, is to be given to interrogations. The entire course comprises two years.

## INTERIOR INSTRUCTION IN THE POLYTECHNIC SCHOOL.

## 1. COURSE OF ANALYSIS.

*Differential Calculus.*

General principles, (8.) Analytical applications, (6.) Geometrical applications,\* (12.)

*Calculus of differences*, (2.)*Integral calculus.*

General principles, (6.) Geometrical applications, (5.) Applications to mechanics, (3.) Certain definite integrals, (2.) Integration of differential equations of the first and second order, (5.) Linear equations, (3.) Integration of equations by series, (1.) Integration of simultaneous differential equations, (2.) Equations of partial differentials, (2.) Geometrical applications, (2.) Mechanical and physical applications, (11.)

*Elements of the Calculus of Probabilities and Social Arithmetic*, (3.)

[The whole course of analysis (including reviews) comprises seventy-eight lectures, of which forty-five are given in the first half of the first year, and thirty-three in the first half of the second year.]

## 2. DESCRIPTIVE GEOMETRY.

*First Part.—Theoretical course.*

This comprises thirty-four lectures, with constant graphical practice.

*Second Part.—Applications.*

Perspective and shadows, (7.) Stone cutting, (15.) Cutting and combining timber, (9.)

[This course extends through the first year.]

## 3. MECHANICS AND MACHINES.

*Mechanics of geometrical motions; or Cinematics.*

Preliminaries, (3.) Geometrical transformations of motion, (8.) Composition of motions, (5.) Of acceleration in geometrical motions, (3.) Of acceleration in some natural motions, (3.)

*Mechanics of forces; or dynamometrics.*

Fundamental principles of the molecular mechanics of systems of material points, (3.) Applications of these principles, (6.) Equilibrium and stability of solid bodies, (9.)

*Mechanics of the motions impressed by forces; or dynamics of systems.*

Preliminaries relating to free material points, (3.) General principles relating to systems of material points, (6.) Dynamics of solids or invariable systems, (4.) Applications of the general principles of dynamics, (5.) Theory and calculation of machines, (2.)

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\*The method of infinitely small quantities is required to be exclusively employed in the applications of the calculus.

*Hydraulics, Pneumatics, and Motors.*

Hydrostatics, (1.) Experimental hydraulics, (4.) Hydraulic machines, (4.)  
Steam-engines, (3.)

[This course comprises seventy-six lectures, including those of review. It extends through two years.]

## 4. PHYSICS.

Preliminaries, (5.) *Heat*, (18.) *Statical Electricity*, (3.) *Magnetism*, (4.)  
*Dynamical Electricity*, (10.) *Acoustics*, (4.) *Light*, (18.)

[This course comprises sixty-eight lectures, and extend through two years. It is entirely experimental.]

## 5. CHEMISTRY.

Preliminaries, (2.) Metalloids, (19.) Metals, (35.) Powder, lime, glass, and pottery, (6.) Organic chemistry, (5.) Organic chemistry manufactures, (5.)

[This course is distributed over two years, with many practical manipulations.]

## 6. COURSE OF GEODESY.

Trigonometry, [reviewed,] (2.) Measure of time, (2.) Measure of angles, (5.)  
Astronomy, (17.) Geodesy proper, (5.) Geographical maps, (2.)

[This course is given in the second half of the second year.]

## 7. ARCHITECTURE AND PUBLIC WORKS

*First part*: Elements of edifices, (18.)

*Second part*: Composition of edifices, (16.)

*Third part*: Ways of communication. Roads, bridges, canals, improved rivers, railroads, (6.)

## 8. MILITARY ART AND FORTIFICATIONS.

*First part*: General notions, (7.)

*Second part*: Temporary fortification, (4.)

*Third part*: Permanent fortification, (7.)

*Fourth part*: Attack and defense of places, (2.)

## 9. COURSE OF TOPOGRAPHY.

[Ten lectures, during second year.]

## 10. COURSE OF COMPOSITION AND FRENCH LITERATURE.

[This course extends through the last year and a half.]

## 11. THE GERMAN LANGUAGE.

[Sixty lectures, during the two years.]

## 12. FIGURE AND LANDSCAPE DRAWING.

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N. B. It should be remembered, to account for the brevity of some important parts of the course, that the Polytechnic School is itself only preparatory to a number of "*Special*" schools, such as those of Civil Engineering, of Military Engineering, of Mining, &c.

It ought also to be mentioned that many of the modifications here introduced into this course have been warmly opposed and censured by various French mathematicians and practitioners.

W. M. G.



## SCHOOLS OF APPLICATION FOR POLYTECHNIC GRADUATES.

The Polytechnic School was instituted originally to supply the corps of engineers, civil and military, from which it developed into a preparatory school for other departments of public service, the special studies of which are continued for from two to four years. The choice of service is determined by the rank which the students attain on the final examination, which is conducted by a special board, no member of which is in any way connected with the school, and all of whom are experts in some of the specialties into which the graduates are to pass. These schools of application are :

*Military Schools.*—(1,) The School for Artillery and Engineers at Metz ; (2,) of Infantry and Cavalry at St. Cyr ; (3,) The Staff School at Paris ; (4,) Imperial School of Cavalry at Saumur. Each of these schools comprises a strictly professional course of from two to three years.

2. *Schools for the Naval Service.*—(1,) The Naval School at Brest ; (2,) The School of Marine Artillery at Paris ; (3,) The School of Naval Architects at Paris ; (4,) The Hydrographic Engineers.

3. *School for Government Civil Engineers, (Corps des Ponts et Chaussées,)* to whom are intrusted the construction and supervision of all public works. The course extends over a period of three years, and is both theoretical and practical.

4. *Schools for Mining Engineers and Directors and Inspectors of the Government Mines.*—The course lasts three years, and embraces, besides a thorough course of studies, the personal inspection of mines and the supervision of actual operations.

5. *School for the Manufacture of Gunpowder (Poudres et Salpêtres.)*—The main work of this school is to impart to pupils destined to this branch of the public service a thorough acquaintance with all the details of manufacture, so as to superintend the government works.

6. *Schools for the Administration of the Tobacco Service,* including a knowledge of chemistry, physics, mechanics, and accounts applicable to the same.

7. *Schools for the Telegraphic Service,* including the construction, repairs, and working of the signals used in the Military or Civil Service.

8. Other public services, as may be designated from time to time, which require thorough preparation in mathematics and natural science. This preparation in the Polytechnic fixes the standard and method for these studies in all the schools of France.



## CORPS IMPERIAL DES PONTS ET CHAUSSEES.

The *Corps Impérial des Ponts-et-Chaussées*, in France, existed as far back as the times of Henry IV, as a body of government engineers under the *Grand Voyer* of the kingdom, but received its present name and functions from the Regent in 1722. Its present organization is due to the Constituent Assembly in 1791. It belongs to the Ministry of Public Works, to which are intrusted all the vast and varied interests connected with the commerce and industry of the country, to which the government makes appropriations, or over which it exercises control or supervision.

## THE SCHOOL.

An essential part of the organization of the Corps is the *Ecole des Ponts-et-Chaussées*, through which alone admittance to the Corps can be obtained. It is established in Paris, on the *Rue des Saints Pères*. It admits internes or *élèves ingénieurs*, and externes; the latter may be of French or of foreign birth; the former must be of French birth, between the ages of 18 and 25, of good moral character, and graduates of the *Ecole Polytechnique*. The externes are required to submit to an examination, consisting of several compositions on the branches on which they are expected to be prepared, a drawing illustrating descriptive geometry, and an architectural design in colors. If these prove satisfactory, the jury allows them to present themselves for two oral examinations in arithmetic, algebra, elementary geometry, rectilinear trigonometry, analytical geometry of two and three dimensions, descriptive geometry with applications to the cutting of stone and carpentry, differential and integral calculus, architecture, mechanics, physics, and chemistry.

The complete course of the school lasts three years, the term each year extending from November 1 to April 30. From May 1 to October 30 they are assigned to places where engineering and constructions are going on.

The branches studied in the school are the construction of roads, bridges, railways, canals, ports, the improvement of rivers, civil architecture, applied mechanics, hydraulics, steam-engines, agricultural hydraulics, applied mineralogy and geology, administrative law and political economy. A certain number of persons not regular pupils are allowed to attend the lectures, on exhibiting cards from the director. Instruction is gratuitous.

It is from the classes of *élèves ingénieurs*, or internes, already mentioned, that the corps of engineers is recruited. After the final examination, at the end of the course, they become *ingénieurs de 3me classe*, and then rise by seniority through the various degrees of rank. Their social standing is very high, taking rank before colonels at the imperial levées, and between all orders among them is observed that kind of etiquette belonging to military service.

On leaving the school, they are at once assigned to service in the first vacancy that occurs, without regard to any special talent any one may possess. However, those who have distinguished themselves are sent abroad to study the manner of executing work in foreign countries.

The whole of France is divided into eighteen districts, each of which is under the inspection of an engineer, entitled *inspecteur-général de 2nde classe*, those of the first class being honorary members without definite functions. The service of the departments is divided between the *ingénieur-en-chef de 1re classe*, and *de 2nde classe*, and the *ingénieurs ordinaire de 1re, 2nde, et de 3me classe*, together with a class of men known as *conducteurs*.



The *ingénieur ordinaire* has the personal examination of all works proposed or in progress; the questions of the establishment of unhealthy trades, of building-lines, and the police of the roadways, also fall within his jurisdiction. He inspects, moreover, the work of the various contractors employed by the State, and "must personally superintend the measurement of the various accounts they certify."

The *ingénieur* of the first class is charged with the preparation of the projects for the improvement of his district, the management of credits and of the monetary matters, the execution of the works either by competition or by *régle*, which means that the State employs the workmen and engages the tradesmen to furnish materials on its own account, the direction of the law proceedings, and the movements of the *employés* of the office..

The central authority is vested in the general council, composed of all the engineers of every degree present in Paris at the time of its holding, and presided over by the Minister, or, in his absence, by the *directeur-général*, or an inspector nominated for that purpose by the Minister. This council pronounces upon the projects and plans of works and all questions relating to construction, all questions of accounts and the property of the State in public works, and questions connected with the fulfillment of their duties by engineers. To this council a regular report is made by the engineers in charge of the public works, approved and commented upon by the inspector, who must visit his district for three months every year, to inquire into all matters connected with this department. All observations on work in progress, and the discharge of duties by local officers, are transmitted to the Minister directly.

Connected with the corps is the very useful body of men known as *conducteurs*, who receive their training in the offices of the engineers, and after an examination in geometry, the theory of numbers, logarithms, plan-drawing, leveling, taking out quantities, measuring work, superintendence, and every thing concerned in carrying a project into effect, they become *conducteurs embrigadés de 4me classe*, and rise, by seniority generally, to the first class, but if they possess particular merit, or can command patronage, they may rise more rapidly. By the law of October, 1850, it was ordered that one-sixth of the engineers should be created from the *conducteurs*. They are engaged upon the field operations and specially-assigned engineering, the superintendence of the workmen, the measurement of completed works, and the preparation of the working plans that are sent out from the engineer's office.

The salaries paid the various classes of engineers are as follows: To the general inspectors of the 1st class, 12,000 francs per annum; of the 2d, 10,000; engineers-in-chief of the 1st class, 5,000 to 6,000; of the 2d, 4,500; ordinary engineers of the 1st, 2d, and 3d classes, respectively 3,000, 2,500, 1,800. The pupils of the school receive 1,200 francs per annum, and 1,800 while engaged in practical service. The office expenses of the engineers are paid by the government, being fixed by the Minister. An additional source of income is the works which the engineers are sometimes allowed to undertake for the communes.

The Corps is represented by a scientific journal, the *Annales des Ponts-et-Chaussées*, published about six times a year, and characterized by its profound theoretical mode of treating all subjects relating to engineering.

## SCHOOLS OF MINES AND MINERS.

The earliest school of mines in France was founded by Louis XV, in 1783, in Paris, with a course of study and practice extended over three years. The winters were devoted to lectures, and the summer months to observation of practical operations with the inspectors on their tours to the government works. The selection of mining engineers was by law confined to the pupils of this school.

In 1795 the Paris school was changed to a practical school of mining, and its pupils, twenty in number, were chosen from the graduates of the Polytechnic, or Central School of Public Works, who had attained the greatest proficiency in mathematics.

In 1802 the establishment was removed to Pesey, in Savoy, where a lead mine was then worked by the State, and a second practical school founded at Greislauterm, in the old department of the Sarre.

In consequence of the disrapture of territory by the political events of 1814 and 1815, the sites of those practical schools were lost to France, and the courses were reëstablished in Paris as the School of Mines.

In 1816 the Miners' School of St. Etienne was founded in the coal district of the Loire, the seat of the great coal and iron operations of France.

In 1845 a school of practical mining was instituted at Alais, in the department of the Gard, to train intelligent workmen to become foremen and officers of mining establishments.

Besides laboratories in connection with these mining schools at Paris, St. Etienne, and Alais, there are government laboratories for analysis and assaying, at Clermont, Grenoble, Marseilles, Vicdessos, and Vesoul—all modeled on that of Paris.

## IMPERIAL SCHOOL OF MINES AT PARIS.

The Imperial School of Mines in Paris is located in the Boulevard St. Michel. Its aim is to educate mining engineers for the service of the State. Its pupils come from the Polytechnic School. Day-scholars may also be admitted who are intended for directors of working-mines and metallurgic establishments. The course of studies covers three years; instruction is entirely gratuitous. Candidates for day-scholars must, 1, be born or naturalized Frenchmen, and be at least 17, or at most 23 years old; 2, prove by a certificate from their home authorities that they have a good moral character; 3, show by a certificate from a physician that they have been vaccinated.

The knowledge required for admission comprises infinitesimal analysis, mechanics, descriptive and applied geometry, physics with special regard to gas and optical instruments, general chemistry, geometrical drawing and shading with Indian ink; legible handwriting, and correct orthography.

Preliminary examinations on the above-mentioned subjects are held in October in the Departments by mining engineers, specially designated for this purpose by the Minister. Scholars of the Polytechnic School, licentiates of science, mathematics, and pupils of the preparatory course who have obtained a certificate of capacity, are exempt from this examination.

To be definitely admitted as day-scholars, candidates must undergo a second



examination during the first half of November in Paris before the council of the school. Pupils who at the final examination at the end of the three years' course show a sufficient degree of knowledge, receive a diploma of capacity. Aspirants for day-scholars' places can be admitted to the preparatory courses connected with the school itself and lasting one year. Candidates must be native or naturalized Frenchmen, be at least 16 or at most 20 years old, and undergo an examination in arithmetic, algebra, geometry, rectilinear trigonometry, analytical geometry, physics, and drawing.

The course of studies is as follows:—

*Preparatory course:* Infinitesimal analysis and mechanics; descriptive geometry (simple and applied;) physics with special regard to gases, steam, heat, and optical instruments; general chemistry; practical exercises in geometrical drawing and shading in Indian ink.

*General course—First year:* Mining, machinery, metallurgy, mineralogy, assaying, paleontology; English and German. *Second year:* Second part of mining and machinery, metallurgy and assaying; geology; English and German. *Third year:* Industrial constructions, construction of railroads, mining legislation, administrative laws, agriculture, irrigation and drainage; English and German.

The *practical* course embraces drawing, working in the laboratories, visiting of mines and metallurgic establishments in the neighborhood of Paris; geological and mineralogical excursions, and the preparation of papers descriptive of such visits and excursions.

#### SCHOOL FOR MINERS AT ST. ETIENNE.

The School for Miners at St. Etienne (*Loire*) is under the Ministry of Agriculture, Commerce, and Public Works. Its aim is to educate directors of mines and metallurgic establishments. Candidates for admission must be 16 years at least and 25 years at most. They must prove by a certificate from their home authorities that they have a good moral character, and that they have been vaccinated. Naval and military men freed from service are admitted to the age of 28.

The knowledge required for admission comprises: French, arithmetic, system of weights and measures, elementary geometry, algebra as far as equations of the second degree, elements of linear drawing. Candidates must, from the 1st of August till the 1st of September, pass a preliminary examination before mining engineers specially designated by the Minister. These examinations are held in the principal cities of the Departments. Candidates from the Polytechnic School who show sufficient knowledge to pass the second examination, are exempt from the first. Candidates who have been declared admissible pass a second examination at St. Etienne before the council of the school. The list made out by the examining jury is presented to the Minister, and he marks those who are to be admitted. The course of studies covers three years; all scholars are day-scholars; instruction is gratuitous. Certificates of capacity in various degrees are given to worthy scholars, on their leaving the school.

The course of studies is as follows:

*First division:* Geology, 20 lessons; metallurgy, 46; mechanics, 77; mechanical preparation of minerals and preparation of coal for market, 5; theory of resistance of materials, 10 lessons.

*Second division:* Mathematics, 22 lessons; physics, 24; descriptive geometry, 20; chemistry, 25; mineralogy, 18; shading and perspective, 8 lessons; stone-cutting and timber-work, 12; accounts, 8; practical working of mines, 26; drawing of plans, 9 lessons.

The school is under the direction of the inspector-general, aided by the chief engineer of mines of the department of the Loire, and professors (who are commissioned mining engineers) of mineralogy and geology; of chemistry and metallurgy; of mechanics, construction, &c.; of geometry, mapping, and drawing; of accounts and the laws of mines.

#### SCHOOL OF MASTER-MINERS AT ALAIS.

The Imperial School of Master-workmen in Mines at Alais (*Gard*), is under the Ministry of Agriculture, Commerce, and Public Works. Its aim is to educate master-miners who possess practical knowledge sufficient to superintend and guide the workingmen, and enough theoretical knowledge to understand and execute the orders of the directors of the mines. Candidates for admission must be at least 16 years old, must produce a certificate of good moral character and a certificate of good health, duly signed by a physician; they must likewise prove by a certificate from a mining-director that they have labored as common workmen for a whole year in some mine, if they are less than 18 years old; for 18 months if they are from 18 to 20 years old; for two years if older. Candidates must undergo a preliminary examination before an examiner designated by the sub-prefect of the *arrondissement* in which they reside. This examination is held in August. It consists of reading, spelling from dictation, simple arithmetical exercises, and some elementary questions on weights and measures. Candidates who pass this examination satisfactorily are at once notified at what time they must be in Alais to undergo the final examination. This examination is also on the above-mentioned subjects and on some practical knowledge. The course covers two years. The term always commences in the first days of November. The school is a boarding-school. The whole expense of a stay of seven months and a-half is fixed at 360 francs. Whole and partial stipends founded by the State are generally only given to miners or sons of miners. Certificates as "master-miners" are given to worthy scholars at the end of the two years' course. The course embraces the following subjects:

I. THEORETICAL COURSE.—1. *Arithmetic*: Simple and decimal fractions, system of weights and measures.

2. *Geometry*: Measuring of lines, surfaces, and simple solids; graphic construction of geometrical problems, drawing of plans, linear drawing.

3. *Physics and chemistry*: The general properties of bodies, specific weight, thermometer, barometer, gas, heat, steam, chemical properties of metals.

4. *Mineralogy and geology*: Rocks and minerals, the geological layers, geological description of France.

5. *Mechanics*: Simple mechanics, such as the lever, wheel, pulley, inclined plane, &c., suction-pumps, detailed description of an exhausting steam-engine.

6. *Working of mines*: Process of working with the pick-axe and with gun-powder, wood-work and masonry of mines, precaution against gas explosions, inundations, &c.; first care to be bestowed on men in cases of accident.

7. *French language*.

II. PRACTICAL COURSE.—This consists in working in the laboratories and in mines, and in excursions to mines in the neighborhood of Alais.



STATE, DEPARTMENTAL, AND COMMUNAL SCHOOLS  
OF  
ARTS AND MANUFACTURES.

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FRANCE, although not yet possessing a governmental system of industrial schools, was earliest in the field to aid special departments of artistic labor, and to institute museums, collections and special schools to stimulate invention, and prepare her artists and artisans for a higher career than they would have attained in the ordinary course of apprenticeship. The establishment of the School of the Fine Arts in 1648; of the government factories of tapestry (1606,) furniture, and porcelain and pottery (1590;) of the Schools of Civil Engineering (1722,) Mining (1783,) and Public Works; of the Conservatory of Arts (1785) and the Imperial Schools of Arts and Trades (1802)—conspired to place the constructions of her engineers, the design and skill of the workshops of France, in advance of those of other countries. Before describing a few of the leading institutions of each class, we will give a survey of Industrial Instruction as it was in 1850, and in 1864, from official documents. Except the great State schools, the institutions herein enumerated have been established mainly by municipal authorities and far-seeing manufacturers, stimulated and aided by the central government, to meet local wants.

INDUSTRIAL INSTRUCTION IN 1850.\*

In the scheme of institutions devoted to technical instruction, the first rank belongs to the Conservatory of Arts and Trades at Paris, begun by that famous mechanic, Vaucanson, as a collection of machines and mechanical tools, and gradually expanded by the government from 1785 until it has become the great museum and archives of the industrial arts. It embraces in its range of operations: (1) a collection of machines, models and designs, with experts to give advice and instruction to those who ask, and motive power to exhibit and test new inventions; (2) a library of technological publications in different languages, including plans of ornamentation; (3) annual courses of lectures on the sciences applied to the great national industries; (4) a school of design. To these sources of practical knowledge the workmen of Paris resort in large numbers, and with great profit to themselves and to the country.

The three State Schools of Arts and Trades at Châlons, Angers, and Aix—the first instituted in 1802, the second in 1811, and the third in 1843, supported by the government, are intended to train skillful workmen; and from them have proceeded a large number of master-finishers, founders, blacksmiths, machinists, carpenters and engineers.

As to the proportions of theory and practice in the course of instruction,

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\* Abridged from an article in the *Revue des Deux Mondes*, by A. Amphori.



the pupils pass seven hours and a half daily in the workshops, and only five hours and a half daily in classes and in the apartments for design. The professors are rigorously obliged, in their lessons, to take the most usual point of view; that from which the pupil can best see how to use the knowledge he acquires. Since the vote was substituted for ministerial selection of professors, two years since, the courses of instruction have been so arranged as to drop out those theoretical gentlemen who are unable to do what they teach.

The principal advantage of these schools is not, in our opinion, the direct influence which they exert upon the national industry. The two hundred and fifty pupils or thereabout who leave them every year, are scarcely the thousandth part of the workmen who grow up in France during the same time; but the schools show a style of instruction which serves as a model for comparison. The pupils carry into private workshops theoretical knowledge which they could not acquire there, and which is most useful in the explanation of practical labor. Although yet imperfect workmen, they improve more rapidly than the others, and sooner become excellent foremen. Although we know that among some foreign nations, habits supply the place of institutions, among us, these schools will stimulate a little our untoward habits. They have another destination, of higher importance; they may become seminaries of professors for the industrial instruction which the country waits to see organized, and for which we are now endeavoring to prepare a way. Once improved by the practical training of the private workshops and manufactories, the best pupils of these schools will become most useful in the development of this special instruction; which needs a body of instructors adapted to its peculiar needs.

An institution established at Paris, the central school of arts and manufactures, also helps the accomplishment of this same work. The similar nature of its instructions alone justifies the assistance granted it by government, which confers upon it a sort of public character.\* During an existence of twenty years, the central school has fully justified the expectations of its founders, it is devoted to the education of civil engineers, directors of machine-shops, and chiefs of manufactories. Besides the four principal courses studied, the mechanic arts, the chemical arts, metallurgy and architecture, it instructs its pupils in all the pursuits of industrial labor. Since chemistry has left laboratories to enter workshops and to perfect there the results of manufacturing processes; since the physical world has been searched for the means of employing heat and steam, which have become such powerful agents of production, industry has ceased to be abandoned to empiricism. Every manufacture has asked from science methods quicker, surer, and more economical. The central school satisfies this demand. By physical and chemical study, it prepares pupils expressly for the direction of industrial labor, just as the polytechnic school, by the study of mathematical science, becomes a seminary for the department of public works, and for some other special professions.

Under these institutions, which have a general character, may be ranked those institutions which we will term local. These may be divided, in respect to their destination, into two great classes; one, consisting of those whose design is to instruct in the applications of some one science to the industrial arts; and the other, of those which confine their instruction to the practice of an art or trade; or to the collateral knowledge necessary to exercise it. To estimate the actual influence of both, they must be considered in the place where they exist.

In the northern section, where manufacturing industry reigns supreme, we see only the arts of design as applied to arts and trades, gratuitously taught. The schools of design established in most of the important towns, are generally of recent creation. The oldest date from the restoration or from the empire, except that three or four, have an earlier origin. For instance, the school of Arras, where some instruction is given, which relates partly to industrial occupations, was founded by the states-general of Artois, in 1775; that of St. Omer in 1780, and that of Calais in 1787. These institutions are every where much valued among the working classes. Some of them contain classes of as many as a hundred and fifty pupils. Some of them are particularly for children, but most for adults.

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\* The State allows the central school an annual sum of \$6,000, which is distributed to candidates (for prizes) by a vote.



Architectural design and practical geometry, as applied to cutting stone, wood, &c., are often among the studies. In all that populous district which extends from the Belgian frontier to the western extremity of Normandy, and contains such manufacturing metropolises as Rouen and Lille, there are only two small institutions which really have the character of industrial schools. One is at Dieppe; it is a school for lace-making and open-stitch for young girls. It was founded during the restoration, and increased during the government of July. It receives about three hundred pupils, and while giving them a primary school course of instruction, it also instructs them in an occupation. It has exercised a favorable influence upon the lace manufacture; there has been organized in connection with it, a boarding department, where some poor girls are supported gratuitously, and educated to become skillful work-women and assistant teachers. The other institutions situated at Mesnières, in the *arrondissement* of Rouen, receives about sixty orphan boys, and trains them for business in workshops appropriate for different trades. Some local societies, as the society of workmen at St. Quentin, &c., endeavor to instruct the laboring classes in some occupations.

In our eastern departments, the domain of industrial instruction is less confined. There are there some schools, some technic institutions, for the working classes. The schools of design are more numerous than in the north, and are more decidedly directed towards manufactures. The manufacturers of Switzerland, Germany, and England, have more than once had upon their fabrics the marks of the designers, engravers, and colorists, trained in the gratuitous schools of the Haut-Rhin. Some schools of design of rather wider scope, do great service to industry. Among these may be especially mentioned the school of Saint-Etienne, where are instructed all the designers employed in the neighboring manufactories, and in particular by the ribbon-makers, who are so very jealous about the good taste of these articles of ornament. Besides instruction in design, there are given from time to time public courses of instruction, established and supported by the towns, and particularly elementary courses in chemistry, in mechanics, physics and mathematics, such as may furnish the workmen with an intelligent understanding of their profession. Among the cities which enjoy to some extent instruction of this sort, may be mentioned Metz, Mulhouse, Colmar, Bar-le-Duc, Besançon, Rheims, Nancy, Dijon, Rive-de-Gièr, Langres, &c. These institutions are sometimes the results of individual effort; thus, at Besançon, a private citizen founded in 1829 a public and free course of study upon mathematics as connected with the arts. At Bar-le-Duc, industrial courses were established by an association of subscribers, and were taken charge of by the commune. Local societies, among which the industrial society at Mulhouse is first in influence and resources, have increased the local activity, and give the initiative to the population in general. In Sémur, a small town of the Côte-d'Or, a private society. Some manufacturers have imitated this example; for instance, in the great establishment of Guebwiller (Haut-Rhin) gratuitous lessons are given to the operatives in linear design, geometry, and machinery.

There are also in the east of France, several institutions devoted more exclusively to special purposes. The most important, whose regulations are worthy of most attention, are at Lyons, Strasbourg, Nancy, and Saint-Etienne. Lyons stands first, both for population and manufacturing wealth. Besides the Lamartine school, in which are given instructions in mechanics, physics, chemistry, and design, and also a course in the manufacture of cloth, a number of private institutions give practical instruction in loom-weaving, and the theory of the decomposition of cloth, (*décomposition des étoffes*;) they instruct also how to set up looms after any required pattern. Instruction is also given in making patterns, in designing for woven fabrics, and in keeping accounts for workshops. These lessons, as will be observed, go to the heart of the industry of Lyons. It is only to be wished that it were more liberally dispensed; and that the city would make it gratuitous. Lyons has also schools for teaching designing of figures, stone-cutting, and several schools of design for journeymen carpenters; but it is to be regretted that payment is necessary for admission to them. Strasbourg has a well organized school of design, maintained by the commune. The practical instruction given there, besides elementary theoretic instruction in mathematical and physical science, includes iron-work at forge and vice, turning, carpentry, lithography, and chemical manipulations. In selecting the workshop for a pupil, reference is had to his tastes and aptitudes. At Nancy



there has been for several years established a "house for apprentices" on an entirely new plan. The results have been considered deserving of encouragement by the council-general of the department of the Meurthe. The apprentices form a family, and call one another brother. Infractions of rules are determined upon by a tribunal composed of all those apprentices who have obtained a certain number of good marks. A good mark is given by vote of all the pupils. The penalties consist of a system of reparations founded upon the nature of each fault. Thus, one who breaks silence when silence is ordered, is condemned to keep silence until permitted to break it. If two apprentices quarrel, they must embrace and become companions at play for a set time. The pupils of this establishment labor in the workshops established in it, and attend the communal schools to receive primary instruction. At Saint-Etienne, a school of mines is intended to furnish conductors of mines, and directors of explorations and mineralogical workshops. As this instruction is gratuitous, workmen may attend the school to be taught mining.

In the department of Doubs, a practical school of horology was founded in 1836, at Morteau, for the purpose of preserving and increasing the beautiful employment which is important to the labor of that section. In the leisure of winter, always so long among the mountains, the farmers, shut in so much by the snow, have no other means of occupying their time. The town of Besançon, the department, even the supreme government, had encouraged the establishment of the school at Morteau, which seemed to promise great success; but different causes having diminished the demand for the clocks from Doubs, the school, after having already done some good, was forced to be closed. Similar institutions have been unable to support themselves at Dijon and Maçon. The departments and towns ought to have afforded them a more liberal support. The same may be said of a school of another species, for mounting looms, established at Rheims by a local society, in which skillful mounters and weavers had already been trained, but which perished for lack of funds.

In this same region, at one of the most ignorant points of the department of the Meurthe, a project is being put in execution to which we wish the best success. It is intended to establish a special school for a branch of industry to which, though humble, a considerable population is confined. The inhabitants of the six communes of the ancient county of Dabo, at the foot of the Vosges, which was united with France only in 1801, have no other means of gaining a living than their forest-rights in the public forests, and the execution of carefully carved wood-work. Their hereditary industry, remaining absolutely stationary, has become surpassed by other products of the same kind, and commerce gradually refuses them. The projected school is designed to instruct these unskillful turners in methods of labor more suited to existing tastes and demands. Instruction will be given in making playthings and domestic utensils, such as those made in Switzerland and in the Black Forest. In order to have some chances of success, it will be necessary to instruct the young, and not the adult workmen, whose traditional habits it would be difficult to alter. These latter, having been exclusively employed in doing coarse work, would find it very difficult to acquire delicacy of hand. With this proviso, the plan of the founders of this school appears excellent; when it has succeeded, it will be another good example of what our eastern departments can offer in the way of industrial instruction.

The southern section of France is not so favored in this respect; it presents a similar aspect to the northern. Schools of linear design of trade, architecture or decoration, existing at Marseilles, Avignon, Montauban, Digne, Aude, Grenoble, Tarbes, Grasse, &c., a few courses of instruction in three or four towns in the elements of chemistry, of physics, of mechanics, of geometry, are almost the only institutions for industrial instruction. The town of Nismes alone is better supplied; perhaps there is not in all France another city where special instruction is given on so extended a scale. A course of design for manufactures embraces instruction in damasked and in stamped flowers. Another course of geometrical design completes the knowledge which the children have received in the elementary schools. The instruction in chemistry comprehends lessons in dyeing, an important branch of local industry. Admission to all the classes is free. A school of weaving, dating from 1836, is liberally opened for theoretic and practical instruction in the manufacture of cloths. The theory is of the processes employed both in brocaded and in plain stuffs; the practice consists in the actual weaving of the cloths in the



loom. The town furnishes the tools, machines, and raw material, necessary for the work. By explaining the art of weaving in two aspects, this school has had an excellent influence upon the manufactures of Nismes. It was only necessary to endeavor to gather into it as many foremen and workmen as possible. In this same department, of the Gard, at Alais, has been established a school of master-miners. The instruction has not so high a character or purpose as that at Saint-Etienne, at least in that part of the course designed for directors of machine-shops. The practical exercises consist in drawing plans both of the surface of the ground and of the mines, and in mining in the mines of pit-coal about Alais. The pupils also practice blacksmithing, wagon-making, and carpentry. Admission is not free, and scarcely any pupils are expected except those maintained by some department, or by some of the coal companies.

In our western departments the two large cities of Bordeaux and Nantes are the only ones which have paid much attention to special instruction. In the capital of ancient Guyenne, in 1834 and 1835, the municipal council founded public and gratuitous courses of instruction in industrial chemistry, mathematics and mechanics, as applied to arts and trades. The chamber of commerce also, a rich and active body, established in 1843 a course of chemistry and natural history. A private society called the philomathic society, whose assistance has often been valuable to the laboring population of Bordeaux, has for six years defrayed the expense of special instruction; the practical part of which consists in linear design and instruction about the steam-engine. At Nantes, besides that the town maintains a free school of design, founded in 1789, there is a private society known as the industrial society, whose efforts for young workmen are now appreciated throughout France, which is at the head of the industrial training of the masses. It receives from the commune, the department, and the State, assistance which is increased by private subscriptions. The workmen are counted by hundreds, whose first steps it has guided in the rude career of labor. The object of this society is two-fold; to give its pupils instruction carefully adapted to their condition, and to arrange for their apprenticeship in different trades.

La Rochelle and Brest have also made some efforts to introduce industrial education in the west of France. At La Rochelle, was established in 1844 a theoretic course in ship-building; at Brest, a society called the society of emulation endeavors to instruct in linear design, in drawing plans, &c. In this part of France, all children, not merely of those of easy circumstances, but of all who are not altogether too poor, attend, without exception, the classical schools. They are often interrupted in their studies, by the inability of their parents to bear their prolonged expenses, and rarely succeed in reducing to practice, even at a late period, the imperfect education they receive. Families unable to send their sons to the high school, content themselves with the ordinary instruction. The idea of special instruction is scarcely a germ in this soil, which seems ungenial to it. Nowhere is the word "professional" applied to instruction in a narrower or falser sense.

The center of France, excepting the department of the Seine, whose establishments deserve a distinct notice, is scarcely less ill supplied than the west. Most of the departments are destitute of graded (*sérieux*) establishments also. Schools of linear design, or of design more or less applicable to industry, exist only at great distances. There are, however, a few institutions in which some practical instruction is given. For instance, the *prytanæum* of Menars, established in 1832 in the department of the Loire and Cher, and recently reopened after having been some time shut, is devoted to industrial studies. The plan of the institution is similar to that of our schools of arts and trades, but unfortunately has not as great resources at command. The city of Tours has established a course in physics and chemistry, but it has not been organized upon a sufficiently wide basis to attract many auditors. At Limoges, the municipal council and the agricultural society, by uniting their efforts, have done much good by means of public and free lessons, in geometry, mechanics, design, modeling, and stereotomy. In the Haute-Loire, Le Puy received the gift of a free industrial school from private subscriptions, the town paying its annual expenses. This institution, though less complete than that of Strasbourg, is constructed upon the same model, and accommodates a hundred children of workmen. There are some special courses at Le Puy also; but the practical applications of science are not brought out there. In the department of



the Corrèze, though small and unkindly treated by nature, we see with pleasure, at Tulle, a free school of mechanical geometry. Linear design is applied there to the drawing of figures and of machines, to stone cutting, carpentry, and architecture.

At the other extremity of the central section, in the department of the Seine, whose riches and activity contrast singularly with the nakedness and simplicity of the country we are leaving, have been united most of the means of industrial instruction which are scattered here and there over the surface of France. Paris, nevertheless, contains nothing comparable with the school of weaving at Nismes, with the private institutions for teaching weaving at Lyons, with the national schools of arts and trades at Châlons, Angers, and Aix. We seek there in vain for an organized system of practical instruction, provided with all resources necessary to meet the public demand. All the establishments of this class in Paris, except the national conservatory of arts and trades, may be classed in two divisions; one appropriated to those in easy circumstances, or who can pay a monthly fee, the other gratuitous, and therefore accessible to the working population. In the former class are the Chaptal municipal college and the Turgot school, in both of which there is a department of industrial teaching; several schools preparatory to the school of arts and trades; schools of architecture, horology, &c. From our present point of view, the latter class calls for our especial attention. The number of public establishments included in it is inconsiderable. Besides the small school of the conservatory, there are hardly any other than free classes in industrial design. Design for woven stuffs does not occupy so prominent a place as it ought; the artistic element of design is preponderant, which will not be surprising when it is known that by a singularity of which our administration affords more than one example, these schools are altogether separate from the department of commerce, and under the direction of that of the fine arts.

In the vast field for industrial instruction among the working classes, the principal burden has fallen upon private institutions established by charity or by economic foresight. In the immense gulf of the capital, the action of these establishments does not appear to the indifferent, or to those immersed in business; but though silent and almost unknown, they are a valuable help to the unfortunate and to the helpless, and very profitable to the community. The institution for apprentices in the city of Paris, under the direction of M. Armand de Melun, trains up to labor, from the pavements of the city and from garrets and misery, a crowd of children who would otherwise have hastened to populate the prisons. While their instructors train their minds by primary instruction, and seek to inspire right sentiments into their hearts, they are gradually prepared for the actual life which awaits them. Another institution, that of Saint-Nicolas, receives several hundred pupils in two establishments, one at Paris and the other at Issy. Its judicious directors mingle a proper amount of elementary instruction with manual labor. Unfortunately the limited resources of this establishment do not permit it to furnish a very great variety of instruction. Other similar institutions are entering the same course. The work-rooms for girls are actual industrial schools for the most feeble and exposed portion of the laboring population, and that needing most care. There are also in Paris small school for apprentices, established almost entirely by the contributions of foremen for poor orphans. Such enterprises are worthy of judicious encouragement by the municipal council.

Other public and gratuitous courses of study, founded by private societies, with different designs and by different means, are assisting to disseminate technical instruction among the workmen. When a man has some property, and is thus in a way to fill a useful place in society and to gain his own living, instruction of this kind, carefully adapted to his requirements, dealing with fact rather than with theory, simple, and appealing to the good sense of the masses, is likely to produce excellent moral effects. I do not say that all these qualifications actually exist; some additions and retrenchments are necessary. The philosophic sentiment of the great task of industrial improvement for the masses is not clearly brought out; and the conditions of true practical instruction are often not fulfilled. Yet many honorable individual efforts have been made in this direction. They have produced real good, and merit effective encouragement from the Parisian municipal authority.



## TECHNICAL SCHOOLS IN EACH DEPARTMENT OF FRANCE.\*

AIN.—The farm-schools of *La Saulsaie* and *Pont-de-Veyle*.

AISNE.—*St. Quentin*.—Course of industrial drawing for adults of all trades; 60 pupils. The Imperial Free Drawing-school; 60 to 70 pupils.

ALLIER.—Two preparatory technical schools at *Moulins*, with about 100 pupils, and an agricultural school at *Belleau*.

ALPS, (UPPER, LOWER, and MARITIME.)—One farm-school in each of these departments.

ARDENNES.—*Charleville*.—A professional school with 300 pupils.

ARIEGE.—A farm-school at *Royat*.

AUBE.—*Troyes*.—Municipal school of drawing and architecture, with 114 pupils. A gratuitous course of German and English, with from 15 to 20 pupils. A sewing-school for girls has 18 boarders and 30 day-pupils.

AUDE.—A farm-school at *Besplas*, with 24 pupils.

AVEYRON.—A chair of agriculture at *Rodez*.

BOUCHES-DU-RHÔNE.—*Aix*.—Imperial school of arts and trades, and a private preparatory technical school, with 155 pupils.

*Marseilles*.—Preparatory school of arts and trades, with 70 pupils.

*La Ciotat*.—Drawing-class, and apprentice system.

Farm-school at *Montaurone*, with 36 pupils.

Schools of hydrography at *Marseilles*, *La Ciotat*, *Arles*, and *Martigues*.

CALVADOS.—*Caen*.—Three public and gratuitous courses for drawing, sculpture, &c., with 112 pupils. Course of agriculture, with 50 pupils; of horticulture, with 20 pupils; and of agricultural chemistry, with 75 pupils. A sewing-school for girls and four orphanages, wherein children of both sexes receive primary instruction and are taught some industrial art.

*Bayeux*.—Two schools in which girls are taught sewing, knitting, and embroidery.

*Lisieux*.—Drawing-school for working men; 20 pupils.

*Vire*.—Public course at the Hôtel-de-Ville, for improving the elementary instruction of the working class, and imparting the scientific knowledge most useful for the local industries. There are about 70 pupils on the average.

*Condé-sur-Noireau*.—Professional courses for the instruction of the foremen and workmen employed in spinning, weaving, and other local industries; 42 pupils.

CANTAL.—*Aurillac*.—Trade-school for drawing, mathematics, sculpture, &c.; 30 pupils.

*Murat*.—Lace-making school; 85 pupils. At this place, and at *Mauriac* and *St. Flour*, there are also sewing-schools, with 25, 40, and 50 pupils respectively. At *St. Paul-des-Landes*, a farm-school, with 33 pupils.

CHARENTE.—*Angoulême*.—Public and gratuitous courses of applied physics and chemistry, with an average attendance of 100, and a course for drawing, with 62.

*Bardines*.—A course of horticulture, attended by about 80 persons.

CHARENTE, (LOWER.)—*La Rochelle*.—Evening school for drawing and geometry applied to the industrial arts; 150 pupils. Farm-school at *Puilboreau*.

CHER.—Farm-school at *Laumoy*.

CORREZE.—*Tulle*.—Departmental trade-school for young workmen; 100 pupils. The technical-schools at the Imperial Manufactory of Arms, with 40 pupils. There is also at *Les Plaines* a farm-school, with 45 pupils.

COTES-DU-NORD.—Farm-school of *Castellaouënan*, with 33 pupils.

At *St. Brieuç*, a school for lace-making, with 30 to 40 pupils, and at *Tréguier* one for sewing and embroidery, with 25 pupils.

CREUSE.—The farm-school of *La Villeneuve*.

DORDOGNE.—The farm-school of *Lavallade*.

DOUBS.—*Besançon*.—Municipal school for teaching the theory and practice of clock and watch-making, established by the municipality in 1862. The course occupies three years, and the number of pupils is 30.

\* Communicated by the Prefects of the Departments.



There are also at Besançon gratuitous courses on the application of mathematics to arts and manufactures, with 12 to 15 pupils, and a drawing-school, with an average attendance of 150 pupils. A chair of agriculture has also been founded there.

EURE-ET-LOIRE.—In this department there are 11 sewing-schools established by charitable persons at *Chartres*, *Illiers*, *St. Luperce*, *Dreux*, and *Nogent-le-Rotrou*.

FINISTERE.—A farm-school at *Trévarez*, a practical school of irrigation and drawing at *Lézardau*, and a chair of agriculture at *Quimper*.

GARD.—*Alais*.—School for educating overseers and foremen of mines, founded by the Government in 1843; it is supported by the town of Alais and the department of the Gard, with a subvention from the State. The number of pupils, all boarders, is 28. The results are very satisfactory.

*Nîmes*.—Weaving-school, theoretical and practical, with a course of pattern-drawing, founded by the municipal council in 1856 at the expense of the town. It is regularly attended by 30 pupils, with most satisfactory results.

*Nîmes* has also an excellent school of design, likewise founded by the municipal council. It comprises four courses:—1. A course of artistic drawing, including the figure, the round, landscape, and painting. 2. A course of ornamental drawing, with modeling and sculpture. 3. A course of linear drawing, including plans, designs of machines, &c. These courses are diligently followed by 145 pupils. To these three the municipality has added: 4. An evening course for adults, in which workmen are taught drawing applied to carpenters' work, stone-cutting, &c.

The municipal council has founded, in addition to the above, a course of chemistry and physics applied to the industrial arts, especially to dyeing.

GARONNE, (UPPER).—*Toulouse*.—School of the fine arts and industrial sciences. In this establishment there are courses of drawing in all its branches, of painting, sculpture, architecture, anatomy, arithmetic, geometry, physics, and chemistry, of algebra, descriptive geometry, perspective, and stereotomy. The number of pupils was about 600 in 1863.

There are also a commercial-school, (private,) with 120 pupils, courses of agriculture, of arboriculture, and an imperial veterinary school.

GIRONDE.—*Bordeaux*.—Evening-classes for adults founded and conducted by the Philomathical Society. There are in all 21 classes, attended by 1,810 pupils. The subjects taught, in addition to reading, writing, and arithmetic, are geography, geometry, (plane, solid, and descriptive,) algebra, mechanics, (with application to steam-engines,) practical hydraulics, drawing, physics, chemistry. The same society has also opened classes for apprentices.

Municipal professional course of mathematics and their applications; 130 pupils.

A naval school supported by the department, the city of Bordeaux, and the Chamber of Commerce. There are from 150 to 200 pupils, who are taught on board the frigate *La Brillante*, moored in the Garonne. Lastly, a chair of agriculture.

HERAULT.—*Montpellier*.—A private commercial and technical school, in which pupils are prepared for the Imperial School of Arts and Trades at Aix.

ILLE-ET-VILAINE.—In this department there are courses of book-keeping and drawing annexed to the college at *Dol*; agricultural-schools at *St. Jouan-des-Guerets* and *St. Meën*; and eight sewing-schools at *St. Malo*, *St. Servan*, and *Fougères*.

INDRE.—Farm-school of *Villechaise*, and a reformatory at *Fontgombault*, kept by the Trappists, who give instruction in agriculture and the trades dependent thereon.

INDRE-ET-LOIRE.—*Tours*.—Courses of drawing, with 180 to 200 pupils; of horticulture, with 150 to 200 pupils; of chemistry and physics, with about 200 pupils.

Farm-school at *Chedigny*, with 33 pupils.

LANDES.—Farm-school at *St. Sever*.

LOIRE-ET-CHER.—*Ménars* and *Blois*.—Professional schools for preparing pupils to enter the schools of arts and trades, &c. There are also sixteen sewing-



schools at *Blois*, *Ménare*, *St. Aignan*, *Meusnes*, *Vendôme*, *Romorantin*, and *Salbris*.

Farm-school of *La Charmoise*.

LOIRE.—*St. Etienne*.—School of miners, founded by Government in 1816, to train mining overseers and foremen; 54 pupils.

The municipality has founded a public course of chemistry applied to the industrial arts, and a drawing-school chiefly directed to forming pattern-designers for ribbons.

*Roanne*.—Drawing-school for workmen.

Agricultural-school at *La Corée*.

LOIRE (UPPER).—*Le Puy*.—Industrial evening-schools, founded by the town, for the instruction of workmen in drawing and mathematics applied to industry. There is also an industrial course annexed to the Imperial Lycée.

LOIRE (LOWER).—*Nantes*.—The schools of the Industrial Society and the Upper Trade School.

Imperial agricultural-school at *Grandjouan*; farm-school at *St. Gildas*.

LOIRET.—*Orléans*.—Upper Trade School, with 90 pupils.

Four sewing-schools.

LOT.—Farm-school at *Le Montat* for 36 pupils.

LOZERE.—*Mende*.—Lace-making school, with 17 pupils.

Farm-school of *Recoulettes*; 32 pupils.

In this department there are also five schools for embroidery, and two orphanages, one for boys, the other girls.

MAINE-ET-LOIRE.—*Angers*.—Imperial School of Arts and Trades.

Municipal drawing-classes, with 50 pupils.

MANCHE.—*St. Lô*.—Course of drawing, theoretical and practical, founded by the municipality for the benefit of the working class; 50 pupils. There is also a course on gardening and fruit-trees.

*St. Waast-la-Hougue*.—School of hydrography.

Sewing-schools at *Coutances* and *Carentan*.

MARNE.—*Châlons*.—Imperial School of Arts and Trades.

*Rheims*.—Industrial School founded by the Industrial Society of Rheims, with 80 pupils, and annexed to it three public gratuitous courses on commercial law, drawing, and manufactures; 70 to 80 pupils.

Public courses of physics, chemistry, and drawing; 250 pupils.

Sewing-schools at *Epernay*, *Montmirail*, and *Sézanne*.

MAYENNE.—Farm-school of *Le Camp*.

MORBIHAN.—Farm-school of *Trécesson*; 30 pupils.

MOSELLE.—*Metz*.—Superior industrial school, founded by the town; 235 pupils.

Private trade-school at *Longwy*.

NIEVRE.—*Nevers*.—School of art, founded by the town; 45 pupils.

Farm-school at *Poussery*.

NORD.—*Lille*.—School of the industrial arts and of mines. Its object is to give technical instruction, on the principal industries of the Nord, to young men who have already received a good general education. Its present organization dates only from 1861, when it was placed under the direction of the Minister of Commerce. Its only revenue consists of the payments of the pupils, with a subvention of 7,000 francs from the department. It had only 30 pupils at first. As soon as the resources of the establishment will permit, evening classes are to be opened for adults.

Class for stokers, founded by the Lille Society of Sciences, and supported by the voluntary subscriptions of manufacturers and others using steam-engines; 15 to 20 pupils.

Academic schools, founded and supported by the city. The courses of painting, sculpture, figure-drawing, perspective and anatomy applied to design, are attended by 250 pupils; those of architecture and ornament by 50; those of applied geometry, mechanics, geometrical and linear drawing by 250; in all, 550 pupils. The results are very satisfactory.

There is also at Lille a superior primary school for the sons of artisans; it has 180 pupils.

*Tourcoing*.—Courses of physics and chemistry founded by the town; 20 to 40 pupils.



Weaving-school for orphans; 14 pupils.

*Roubaix*.—School of drawing applied to manufactures; 14 pupils.

Course of physics and chemistry adapted to the local industries; 130 pupils.

*Douai*.—Academic schools for drawing, &c.; 130 pupils, many of them adults.

*Valenciennes*.—Academic schools for painting, sculpture, and architecture, the pupils respectively numbering 60, 67, and 40; in all, 167. The expenses are borne by the town.

*Cambrai*.—A trade-school (private) for commerce, manufactures, and agriculture; 186 pupils. There is also another school of the same kind managed by the Christian Brothers, with 90 pupils.

*Bailleul*.—Lace-making schools, with 800 pupils, and sewing-schools with about 600.

*Lille*.—Three sewing-schools, with about 240 pupils.

*Loos*.—Sewing-school, with elementary education; 90 to 100 pupils.

OISE.—Farm-schools at *Mesnil-St.-Firmin*, and at *Beauvais*.

ORNE.—*Alençon*.—Public courses of drawing, arithmetic, and geometry, for workmen; 50 pupils in winter, 25 to 30 in summer.

Farm-school at *St. Gauthier*.

PUY-DE-DOME.—*Clermont*.—Communal trade-school, supported by the town; 250 pupils.

*Volvic*.—School of architecture; 20 pupils;

PYRENEES (LOWER.)—Farm-school of *Talon*.

PYRENEES (UPPER.)—Farm-school at *Virens*, near Lourdes; 30 pupils.

*Tarbes*.—Municipal trade-school, with 80 pupils.

PYRENEES (EASTERN.)—Farm-school of *Germainville*; 33 pupils.

RHINE (LOWER.)—*Graffenstaden*, near Strasburg. Trade-school.

RHINE (UPPER.)—*Mulhouse*.—Trade-school. Under this title have been combined three special schools, having the same staff of professors and premises common to them all. They are—

1. The Free Secondary School, with very nearly the same curriculum as the imperial lycées, but with the addition of four elementary classes for boys between the ages of 7 and 12.

2. The Industrial School for boys from 14 to 18 years of age, who, in addition to scientific and literary instruction, are taught theoretically and practically the construction of machines, or mechanical weaving and spinning, or the chemical arts connected with the dyeing and printing of tissues.

3. The Chemical Laboratory, the courses of which occupy two years.

This school has in all its departments a total of 312 pupils.

A theoretical and practical school of weaving by machinery has been established at Mulhouse under the auspices of the Industrial Society of the town. It is supported by voluntary subscriptions, and managed by a committee of seven members, selected from among the principal resident manufacturers. There are at present 36 pupils of the first year, the same number of the second, and 42 of the third, which is the greatest number that can be accommodated. The charge for admission to both the theoretical and practical courses is 600 francs a year; to the theoretical only, 300 francs; and to the practical only, 400 francs. There are also evening courses for workmen at 25 francs per month, but this charge is reduced almost to nothing for deserving workmen.

Mulhouse has also a drawing-school, founded by the Industrial Society, chiefly intended to form pattern-designers. There are 70 pupils, many of whom are admitted gratis; the others pay 4 francs a month.

There is, besides, a trade-school for youth of the Jewish community. It has at present 47 pupils. They are admitted from 14 to 16 years of age, and remain three years in the establishment.

Mulhouse has excellent municipal schools for both sexes. The boys' school is divided into three: the elementary-school (four years,) the middle-school (three years,) the higher-school (two years.) The number of boys in all of them amounts to about 1,800. The school-fee is 20 to 30 francs a year, but many are admitted gratuitously.

The municipal school for girls is attended by about 1,200 pupils. They receive a good general education, and are taught sewing, embroidery, and other occupations proper for their sex.



Lastly, Mulhouse has a superior school of sciences and letters, constituted by imperial decree in 1855, under the authority of the Minister of Public Instruction, and supported by the town. Its special object is to teach the applied sciences, mechanics, descriptive geometry, physics, chemistry, drawing, &c. There are also lectures on the literature and history of France. Certificates of capacity for the applied sciences are granted to deserving pupils. The number of pupils inscribed is at present 30, but more than 200 persons often attend the lectures.

*Guebwiller.*—Popular library and evening-school founded in 1858; 500 pupils chiefly of the working class.

There are also at Guebwiller evening-schools for girls and women employed in factories during the day; 145 pupils.

*St. Marie-aux-Mines.*—Upper trade-school, founded in 1863, to prepare youth for industrial and commercial occupations. Fee, 5 francs per month. Four hours' instruction daily, from 8 to 10 in the morning, and 2 to 4 in the afternoon. The number of pupils at present (1864) is 17 only.

There are also in this town gratuitous technical evening classes for adults, attended by about 130 pupils.

**RHONE.**—*Lyons.*—The gratuitous professional school of *La Martinière*, so called from its founder, Major-General Claude Martin, a native of Lyons, who died at Lucknow in 1800, in the service of the King of Oude; 500 pupils, all belonging to the artisan class, are here educated during the day, and 200 adults attend classes in the evening.

The Central School for Industry and Commerce was founded in 1857 by an association of merchants and manufacturers, and placed under the direction of M. Girardon, professor at La Martinière, and at the Imperial School of Fine Arts. The number of pupils is at present 80, all out-door. The school hours are from 7 till noon, and from 2 till 6 in the evening. The pupils are admitted at 15 years of age, after an examination.

The course of instruction, which extends over three years, comprises arithmetic, algebra, elementary geometry, trigonometry, descriptive geometry, analytical geometry, the elements of the differential and integral calculus, industrial physics, chemistry, (organic, inorganic, and analytical,) mechanics, construction of machines, metallurgy, resistance of materials, geology, mineralogy, natural history, book-keeping, English language, drawing of machines, &c. There are also workshops for practice in the manual arts. The instruction is given in the form of lectures, the pupils being permitted to make objections and ask explanations. After the three years' study, they undergo general examinations, and if deserving, obtain diplomas.

The School of Fine Arts, especially intended to give such instruction as may be useful to the local industries.

Course of instruction for stokers; two hours weekly, generally attended by about 50 pupils.

Theoretical course of instruction for silk-workers; 80 pupils.

Course of chemistry applied to dyeing, founded in 1860; 70 pupils.

Course of artistic design for adults, founded in 1853. There are on the average 250 to 300 pupils in the year; the lessons are given three evenings per week, from 6 to 8 o'clock.

Course of linear drawing, applied to various trades, for adults. Founded in 1849. Three lessons per week of two hours each; 200 pupils in the year.

Course of horticulture and agriculture, founded in 1858. About 60 pupils yearly.

Practical school of horticulture, at *Ecully*, near Lyons. The lessons are given on Sundays, and are attended by 300 persons on the average.

Course of commercial book-keeping for females, founded in 1857. The studies occupy two years, and the average of pupils is 75. The more deserving receive diplomas on leaving.

Course of artistic and industrial drawing for females, founded in 1856 by the Primary Instruction Society. The annual number of pupils is about 75; three lessons per week of two hours each.

Adult classes for males, founded by the above-named society; 110 pupils.



*Tarare*.—Professional courses. Drawing applied to patterns of tissues and embroidery, physics, and mechanics; 80 to 100 pupils.

SAONE-ET-LOIRE.—*La Creusot*.—Industrial-schools for both sexes. Attendance seven hours a day. Number of people: boys, 900; girls, 700. There are also evening-classes for adults, and a lace-making school, with above 200 pupils.

Farm-school at *Le Montceau*.

UPPER SAONE.—*St. Remy*.—Industrial school, with 75 pupils.

Farm-school at the same place.

SARTHE.—*Le Mans*.—Course of industrial and ornamental drawing; 100 pupils; three lessons weekly in the evening. Sewing-school for girls, with 30 pupils.

*La Flèche*.—Trade-school, (private,) with 58 pupils.

Farm-school at *La Chauvinière*.

SAVOY (UPPER).—*Sallanches*.—Clock and watch-making school, founded and supported by the town, aided by a subvention of 1,200 francs a year given by the Emperor; 10 pupils. There are two other schools of the same kind at *Cluses* and *Thônes*, the former with 15 to 25, the latter with only 4 pupils.

SEINE.—The *College Chaptal* and the *Ecole Turgot*.

The municipality of Paris has established seven industrial drawing-schools in different parts of the town, some of which are very successful.

SEINE-ET-MARNE.—A private school, with workshops for the practice of manual labor at *Lagny*.

SEINE-ET-OISE.—*Versailles*.—Public courses of geometry, drawing, &c., supported by the town.

SEINE (LOWER).—*Rouen*.—Professional courses, founded by the town. The studies occupy three years; 90 pupils. There are similar courses at *Le Havre* and *Montvilliers*, with 30 and 60 pupils respectively.

SEVRES (TWO).—*Parthenay*.—Course of agriculture, dependent on the primary normal school, chiefly intended for the pupil-teachers, to whom the lectures are given on Thursdays. The public day is Wednesday.

SOMME.—*Amiens*.—Public courses, founded by the Industrial Society.

Chemistry applied to dyeing; 100 pupils.

Mechanics; 100 pupils.

English language; 60 pupils.

German language; 20 pupils.

TARN.—*Castres*.—Trade-school, founded and supported by the municipality to give the instruction required for the local industries. It contains 39 pupils of the first year; 37 of the second; 28 of the third; 7 of the fourth; and 6 of the fifth; in all, 117 pupils.

TARN-ET-GARONNE.—*Montauban*.—Course of mathematics, geometry and mechanics applied to arts and trades. This course, which is public and gratuitous, was founded in 1828 under the auspices of M. Ch. Dupin. It is supported by the town; 50 pupils on the average.

Course of drawing, linear, graphic, and from the round, founded and maintained by the town; 60 pupils.

There is also a course of arboriculture and horticulture, with 30 pupils.

VAR.—Farm-school of *Salgues*; 33 pupils.

VAUCLUSE.—*Avignon*.—Public and gratuitous courses of drawing, chemistry, physics, and mathematics, founded by the town for the benefit of workingmen.

Farm-school at *St. Privat*.

VIENNE.—Farm-school of *Monts*.

VIENNE (UPPER).—*Limoges*.—The Haute-Vienne Society of Agriculture, Science, and Art, has here founded:—1. A drawing-school for boys; 100 pupils. 2. A drawing-school for girls; 50 pupils. 3. Modeling-school for boys; 30 pupils. 4. School of painting on porcelain, for girls; 15 pupils. 5. School of geometry; 60 pupils.

Farm-school at *Chavaignac*.

VOSGES.—Farm-school at *Lahayevaux*.

YONNE.—Drawing-schools for adults at *Auxerre*, *Joigny*, *Sens*, and *Villeneuve-sur-Yonne*.

Farm-school at *Orme-du-Pont*.



# IMPERIAL CONSERVATORY OF ARTS AND TRADES,

AT PARIS.

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## HISTORICAL DEVELOPMENT.\*

THE first attempts to form a collection of machines and looms such as that now kept at the Paris Conservatory, were made by Vaucanson, at the Hotel de Mortagne, in the Rue de Charenton, where he allowed artisans to study them for the purpose of instruction. At his death he bequeathed the whole to the Government, which accepted the legacy and purchased the Hotel de Mortagne. M. de Vandermonde was the first curator of this industrial museum, and, under his skillful management, from 1785 to 1792, 500 new machines were added to the collection.

As soon as the revolutionary tempest began to subside, and men's minds had returned to a calmer state, measures were taken to collect and save from dispersion the artistic and industrial riches of the institutions which had been destroyed. The Convention, by a decree of the 23rd Pluviose, year II. (11th February, 1794,) appointed a temporary commission on which were placed several persons eminent in the sciences and industrial arts, for the purpose of collecting in suitable depositories *the books, instruments, and other objects connected with science and art that might be useful for public instruction*. These articles, obtained from numerous and different sources, among others from the collection of models belonging to the old Academy of Sciences, were consigned, some of them to the Louvre, others to the Rue de l'Université, and the rest were added to the collection at the Hotel de Mortagne.

Such was the still precarious state of things when, on the 19th Vendémiaire, year III. (13th October, 1794,) the National Convention, on the motion of Grégoire, Bishop of Blois, adopted a decree which formed the first regular constitution of the Conservatory of Arts and Trades. These fundamental articles were as follows:

Art. 1. There shall be formed in Paris, under the name of *Conservatory of Arts and Trades*, and under the inspection of the Commission of Agriculture and Arts, a collection of machines, models, tools, designs, descriptions, and

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\* Abridged from Special Report of M. Morin, Director, to Minister of Commerce, Programmes, &c.

books in all kinds of arts and trades; the originals of instruments and machines invented or improved shall also be kept at the Conservatory.

2. Explanations shall there be given on the construction and use of tools and machines employed in arts and trades.

3. The Commission of Agriculture and Arts, under the authority of the committee with which it is in communication, shall, in such quarters as may be deemed useful to the Republic, use every means of improving arts and trades, and principally by the distribution of descriptions, designs, and models.

4. The Conservatory of Arts and Trades shall be composed of three demonstrators, a draughtsman, &c.

The premises at first selected for the seat of the Conservatory were the buildings of the *Garde-Meuble*, (furniture stores,) but political changes and other causes prevented this design from being realized.

The constitution of the Conservatory, and the functions attributed to it, among which was the duty of awarding prizes to citizens who had introduced useful inventions, led to so great an increase of the collections that it was indispensable to provide premises extensive enough to receive them all. An application was accordingly made to the Directory that the old Abbey of St. Martin might be granted for the purpose.

But this request, though granted by the executive, was not sanctioned by the Council of Five Hundred, which, in the sitting of the 14th Vendémiaire, Year V, (5th October, 1796,) under the pretext of economy, adopted the following resolutions:

That, for the present, no further outlay shall be made on account of the Conservatory of Arts and Trades, except what is absolutely necessary to prevent the loss or deterioration of the instruments and machines. In consequence, all the salaries of the members and servants of the Conservatory are suspended.

That the National Institute shall express its opinion as to the most economical means of bringing into one place those of the said instruments and machines which are worth preserving, and of rendering them serviceable to the Republic.

Notwithstanding these resolutions, which apprised the members of the Conservatory that it is sometimes dangerous to be too zealous in one's duties, they nevertheless persisted in their efforts, and, on the 7th Nivose following, the Council of Ancients, acting on a very energetic report drawn up by Alquier, rejected the resolution of the Council of Five Hundred, and adopted the following:

Art. 1. The portion of the buildings of the old Abbey of St. Martin-des-Champs, and the grounds tinted red on the plan annexed to this resolution, are placed at the disposal of the Executive Directory for the use of the Conservatory of Arts and Trades.

2. A sum of 59,600 francs, to be taken from the funds voted for the extraordinary expenditure of the year VI, is placed at the disposal of the Executive Directory for the repair of the said buildings, for appropriating the premises to their future use, and for paying the indemnity, if any be due, to the sub-tenant of the said buildings.

These buildings, however, which had been used as a manufactory



of arms, were not transferred to the members of the Conservatory till the 12th Germinal of the Year VII. The members at the time were :—J. B. Leroy, Conté, and Molard, demonstrators, and Beuvelot, draughtsman. Some time after, Montgolfier replaced Leroy, and Grégoire succeeded Conté. This mode of management was retained till the year IX; Molard then became sole manager, and the council ceased to meet.

As early as 1796, when drawing, applied to industry and descriptive geometry, which is its basis, were not taught in any establishment intended for industrial education, Molard had attempted to annex to the collections an elementary school of drawing and of the first rudiments of the geometrical sciences. From this school, then almost the only one of its kind, proceeded a number of pupils who, in different ways, became useful to their country, and several eminent manufacturers, among whom the Conservatory can mention with pride M. Sellière, spinner at Senones, (Vosges,) M. Emile Dollfus, (of Mulhouse,) and M. Schneider, ex-minister, and now vice-president of its council. Under the management of M. Le Blanc, this school became the nursery of geometrical drawing, as it has been so well developed in the Schools of Arts and Trades, and in the technical schools of the country. The present professors of geometrical drawing at the Polytechnic School and the School of Bridges and Roads, as well as the School of Mines, and the Central School of Arts and Manufactures, were all taught by Le Blanc at the Conservatory.

In 1810, when the continental blockade almost entirely prevented the importation of cotton goods, and the Government was very desirous of developing the manufacture of cottons, Chaptal established a spinning-school at the Conservatory. Looms were also put up in the old church of the abbey, for the purpose of instructing weavers, who afterwards found employment in private manufactories. This weaving-school, though essentially a temporary institution, and having a character foreign to the more general object of the Conservatory, was discontinued after it had trained a sufficient number of workmen to give an impulse to the trade.

We thus see that, with the exception of the elementary drawing-school and this temporary workshop, the Conservatory had not, down to this date, any other object than the forming of collections, open to the public, of models of the machines, looms, and apparatus employed in the industrial arts. The functions of demonstrator have in reality never been fulfilled in the proper sense of the word, for the very simple reason that explanations given on the spot, in

galleries open to a promiscuous crowd of visitors, were well nigh impracticable. No such demonstrations have therefore ever been given, and at the present day, when these galleries are sometimes frequented by 2,000 or 3,000 persons in the course of the day, they are so inconveniently crowded, that the impossibility of permanent demonstrations becomes still more manifest; nevertheless, whenever explanations are solicited, from any motive more elevated than mere curiosity, the officials of the establishment are always ready to give them.

But what can not be done in these crowded galleries is accomplished with ever-increasing success in the amphitheatres; these were first opened in 1819 for instruction in the applied sciences, which has received the successive developments hereafter described. A royal ordinance, dated 5th May, 1817, appointed for the direction of studies at the Conservatory, a council of improvement which was presided over by an inspector-general, (the first president was the Duke de la Rochefoucauld-Liancourt, afterwards Duke de Doudeauville,) and of which the director and twelve other gentlemen eminent in science and art were members. This council was to give its advice on all matters, and make any suggestions which it thought calculated to extend and multiply the advantages that the Conservatory of Arts and Trades was capable of conferring on the national industry, and especially on the means of securing to every branch of the establishment the greatest possible degree of perfection. Another decree, of the 25th November, 1819, followed by a ministerial decision of the 2d December, appointed the council as follows:—Duke de la Rochefoucauld, peer of France, *president*; Count Berthollet, Count Chaptal, MM. de Mirbel, Gay-Lussac, Arago, Molard, members of the Institute; M. Ternaux, manufacturer; M. Darcet, inspector of the Mint; M. Scipien Perrier, merchant; M. Widmer de Jouy, manufacturer; M. Welter, manufacturer.

Such was the scale of the institution in 1819. Limited to collections for the increase of which very scanty sums were allowed, no longer receiving models of newly-invented machines and apparatus, and having never been able to organize the service of its official demonstrators, it only offered to industry a mute museum, from which the manufacturer or artisan might doubtless derive useful instruction, but altogether isolated from the principles which should form its base. The authors of the decree of November and the ministerial decision of December, 1819, were well aware of this fact, and they therefore decided on establishing at the Conservatory a public and gratuitous course of public instruction on the applica-



tion of the sciences to the industrial arts. This instruction, which was founded chiefly by the enlightened efforts of M. C. Dupin, at first comprised only three courses:—A course of mechanics and a course of chemistry applied to the arts, and a course of industrial economy. The first professors named were MM. C. Dupin, Clément Désormes, and J. B. Say. They were thenceforth allowed the same salary and privileges as the professors of the College of France and of the Museum of Natural History.

In 1820, a royal decree for the regulation of the Conservatory of Arts and Trades declared:

Art. 1. The Council of Improvement (*Conseil de perfectionnement*) of the Royal Conservatory of Arts and Trades shall be re-constituted under the name of *Council of Improvement of the Conservatory and Schools of Arts and Trades*.

2. The Council of Improvement shall deliberate on the system of instruction and of work, on the sale of the products of the Royal Schools of Arts and Trades, and on the regulations and programmes made or to be made. It shall, in the first instance, take cognizance of the regulations at present existing, and shall present a special report on the maintenance of the same or on the modifications that may be deemed advisable.

3. Every year the Council of Improvement shall draw up a general report on the state of the Conservatory, and of the instruction there given, and shall present observations on the reports sent in from the School of Arts and Trades, which our minister shall have communicated to it. This report, with the accompanying observations, shall be presented to our Minister of Commerce and Manufactures. The result shall be submitted to us.

For several years, and till 1832 or 1833, the council did indeed devote its attention to the different questions relative to the schools of arts and trades, but in a somewhat perfunctory manner, and without taking any real and continuous action. The application of the physical sciences becoming every day more extensive, a course of physics applied to the arts was considered absolutely necessary; it was founded by a decree of 1829, and thus added fresh popularity to the courses of the three first professors, which were already very numerous attended. Another decree, dated 25th August, 1836, made three additions to the instruction already given; they were:—A course of cultivation; a course of mechanics and building applied to agriculture; and a course of agricultural chemistry.

But the seven courses thus established were still insufficient for the increasing developments of industry and for the general demand of more scientific instruction; consequently in 1839 another royal decree, dated 26th November, founded five new public and gratuitous courses, viz.:—A course of mechanics applied to industry; a course of descriptive geometry; a course of industrial legislation; a course of agriculture; a course of chemistry applied to the arts. The course of cultivation, some few days later, was constituted a

second course of agriculture, and the number of courses was thus raised to ten.

A royal decree of the 24th February, 1840, modified the organization of the Council of Improvement, which thenceforth was composed of the professors only, without the coöperation of other members. From this time the Council of the Conservatory ceased to exercise the control over the schools of arts and trades which had been assigned to it by the decree of 1820.

On the other hand, the council was directed to present to the minister a draught of regulations both for its own interior organization and for the conducting of the public courses, as well as for the preservation, increase, and publicity of its collections. These regulations, approved on the 1st December, 1843, were drawn up on the basis adopted for the College of France and of the Museum of Natural History. In conformity with the practice of those establishments it was decided that in case of a chair becoming vacant, the new professor should be chosen from two candidates, designated, one by the Institute, the other by the Council of Improvement.

At the same time that the regulations of 1843 thus assimilated the Conservatory to our great scientific establishments, they also deprived it of the direction of the studies in the schools of arts and trades.

But in 1848 necessity and expedience supersede the regulations. On the one hand, a decision of the Minister of Agriculture and Commerce, considering that, "though the system of national education is liberally organized for primary and secondary instruction in letters and science, the case is very different as regards the teaching of the sciences applied to industry," charged the professors of the Conservatory of Arts and Trades, united in a commission, to organize a general system of teaching the applied sciences, and decided that the courses of the Conservatory should henceforth form the higher degree of that instruction.

A report on this important question was drawn up by the council and presented to the minister; but the events that supervened prevented the immediate accomplishment of those changes which the progress of French industry already demanded at that time. Moreover, from 1848 to 1855, several professors of the Conservatory were successively charged to inspect the Schools of Arts and Trades, as well as to revise their regulations and programmes. Lastly, the competitions for vacant masterships in those schools came regularly, held at the Conservatory, and several of its professors are always on the jury. In fact, it is difficult to conceive that all the questions



relative to teaching in the Schools of Arts and Trades can be better discussed and solved by any other authority than the Council of Improvement, which, as now organized, is composed, in addition to the fourteen professors, of ten members selected from among the most eminent manufacturers.

In 1848 a ministerial decision created a course of ceramics at the Conservatory, which the Director of the Sèvres manufactory was to give; but after the death of M. Ebelmen these lectures were not continued by his successor, though the course, till then given gratuitously, has not been officially suppressed.

A decree of the 13th September, 1852, added two new courses to those already existing. They were founded at the instance of the Paris Chamber of Commerce under the title of Course of Spinning and Weaving, and Course of Dyeing, Printing, and Dressing of Tissues. Another decree of the 30th November, 1852, added a course of zoölogy applied to agriculture and industry, and in November, 1854, a course of civil architecture was also founded, which raised to fourteen the number of gratuitous public courses in the applied sciences now provided for at the Conservatory. On the death of M. Blanqui, who had succeeded J. B. Say in the chair of industrial economy, the views then in the ascendant induced the ministry to transform that course into one of industrial administration and statistics.

At the same time that the oral teaching was thus extended, that which the industrial public can acquire from the examination of models and machines, as well as from observation and experience, received no less important augmentations. All the collections had been classified, since 1849, in methodical order; a complete inventory and a catalogue had been made, and every object exhibited is now accompanied by a card explaining its use.

A gallery of experiments and of machines in motion, the plan of which had been prepared as long ago as 1849, has been completed in the old church; reservoirs of water in the tower, and two steam-engines, together of 30-horse power, serve to keep in motion a great number of hydraulic machines and machine tools.

But this gallery has a still more important use; it serves the purpose of trying, either at the demand of the different ministries, or of private manufacturers, the new machines and apparatus presented to the Conservatory for examination. Reports, stating the results of the experiments, which are usually made in the presence of the inventors, are drawn up, placed at the disposal of the public, and even published, almost entire, in the *Annales du Conservatoire*.

This important branch, which has not been forced on the executive by any superior order, but has been organized solely in the interests of industry, has been in operation ever since 1852.

Except the expense of the installation, the trials are made gratuitously, and more than two hundred reports have already been drawn up, not one of which has ever given rise to complaint, a fact which clearly proves the care and impartiality with which the experiments are conducted. The Conservatory also undertakes the verification of the standard weights and measures required by the foreign governments which have successively adopted the French metrical system.

To the new galleries of models, which with the old ones are worth above 1,300,000 frs., must be added the library, containing more than 18,000 volumes of works on the sciences and industrial arts, and the gallery of drawings, in which more than 7,000 designs, of the most useful and newest machines, to scale and with dimensions given, are collected and placed at the disposal of the manufacturing world. Here also are kept the collections of expired patents, which may at any time be inspected by the public.

The universal exhibitions have enabled the Conservatory to obtain new machines, models, and drawings. Extraordinary credits, placed at the disposal of the Director in 1851, 1855, and 1862, and the munificence of French and foreign manufacturers, have now so increased these scientific and industrial riches that the galleries are too full to admit of more additions. The consequence has been that in proportion as the collections increased, and the teaching was developed by the addition of new courses, the inadequacy of the buildings became more and more felt. The plan of enlargement adopted in 1842 had not been fully executed when it was discovered to be insufficient. In the year 1850, the Emperor, then President of the Republic, honored the Conservatory with his first visit, and soon afterwards decided on adopting a far more complete project, the execution of which, for divers reasons, was not commenced till 1862.

As early as the time of the London Universal Exhibition in 1851, our industrial artists, alarmed by the extraordinary efforts England had determined to make to dispute with France the sceptre of taste, demanded, as they do now, that a museum and centre of studies should be created in France for art applied to industry. Responding to this desire of the industrial interest, the Director of the Conservatory, in a memorial addressed to the Emperor in 1854, expressed himself as follows:



“After a first visit to the Conservatory in 1850, your Majesty was pleased to command that a special bill should be presented to the Legislative Assembly for the completion of the works of enlargement already begun, and a credit was demanded for the purpose; the financial difficulties of the moment, however, caused this project to be postponed. Since that epoch, the Universal Exhibition of London has proved to England the superiority of France in the arts dependent on taste, form, and color. Instead of disputing the fact, the English have at once set to work, with their immense resources and habitual energy, to found museums and drawing-schools all over the country. The Queen and private individuals have stripped their galleries to enrich the museums of practical art with the finest specimens of Sèvres porcelain, bronzes, sculptures, &c. In England, primary teachers are now compelled to learn drawing, that they may be able early to habituate children to the rules of *form* and *color*.

It would seem as if the English were bent on operating on the human species as they have on races of animals, so as to transform a nation of traders and artisans into a nation of men of taste. How far the Anglo-Saxon race is susceptible of this transformation is a philosophical question beyond my province; but one thing is certain, namely, that a few years hence England will have made immense progress in the arts of design. In France, on the contrary, narrow views of cheap production constantly tend to the degradation of art, and if a great establishment, combining some of the most perfect types and models of ancient and modern art with methodical teaching be not available constantly to revive and correct taste, there will be reason to apprehend a decline.

Your Majesty has already been solicited by the ablest of our artists to found a great school of drawing at the Conservatory of Arts and Trades, and thus to realize the idea conceived in the beginning of the present century by the Emperor Napoleon I.”

The apprehensions expressed in this letter, as far back as 1854, were confirmed by the reports of several members of the jury at the Universal Exhibition of 1862, and they now proclaim the urgency of regaining the time lost in this respect. Almost at the same date the Paris Chamber of Commerce expressed a similar wish in a letter addressed, on the 30th January, 1854, to the Minister of Agriculture, Commerce, and Public Works, to the effect that “great advantages would accrue from the opening of a museum of industrial designs and models of ornament at the Conservatory of Arts and Trades, as well as from the construction of halls sufficiently spacious to receive the pupils who might desire instruction.”

On the 17th February, 1860, the Director of the Conservatory, accompanied by M. Schneider, Vice-President of the Council of Improvement, made an application to the Minister of Agriculture, Commerce, and Public Works, for the appointment of a commission charged to present, as early as possible, a general plan of organization for teaching the sciences and arts applied to agriculture and industry. The minister of the day, M. Rouher, at once admitted the principle of the proposition, declared that it harmonized too well with the views of the Emperor's Government not to be immediately followed up, and that it was one of the logical and necessary

consequences of the position in which French industry would thenceforth be placed.

In 1862, after the London Universal Exhibition, the director and sub-director of the Conservatory, in reply to an appeal made by the Imperial Commission, which had called upon the members of the jury to point out all the measures to be adopted in the interest of our industry, presented a special scheme for organizing technical education in France by utilizing and connecting existing institutions.

After stating at length the origin and progress of the Conservatory of Arts and Trades, as well as the efforts perseveringly made by its director and council to carry out its regulations, which give it (Art. 17) "the mission of expressing an opinion on the organization of industrial education, and on the means of making the lectures and institutions of the Conservatory more and more useful for the progress of industry," it will be appropriate to indicate the results obtained by the fourteen courses which constitute the public and gratuitous teaching of science applied to industry at the Imperial Conservatory of Arts and Trades.

The yearly reports addressed to the Minister of Agriculture, Commerce, and Public Works, show that the number of persons attending the public courses of the Conservatory is constantly increasing. In the year 1862-63, from November to the end of April, the auditors for all the courses and lessons amounted to the enormous number of 176,829, notwithstanding the absence of two professors owing to illness. The great amphitheatre of the Conservatory will accommodate 700 persons, the small one 360 persons, and they are often insufficient.

When these courses were first started, Sunday appeared to be the day preferred by the public; but as the instruction given came to be more appreciated, the attendance on the week-day evenings became more numerous, and there is good reason to prefer those sittings to the Sunday ones, at least for continuous lessons. Another circumstance which must not be forgotten is that the winter season is better for the evening lessons than either spring or autumn. When the days get long, the workshops keep open later, and then the studious youth and foremen who are there employed can not get to the lecture-room in time. The consequence is that every year regularly in the month of April the number of hearers undergoes a great diminution. This result, which is also noticed with regard to lectures given elsewhere, indicates that, as a general rule, public courses ought to be generally held in winter.



The oral teaching of the Conservatory of Arts and Trades is exclusively devoted to science applied to industry; it addresses an audience for the most part composed of apprentices, foremen, and workmen already instructed; but besides these there are also some few foreign professors and many persons who take an interest in the progress of technology. These public and gratuitous sources thus open, with a liberality truly French, to both natives and foreigners, constitute a free instruction analogous to the lectures at the Sorbonne, the College of France, and the Museum of Natural History. Its object is rather the applications of science than science itself properly so called; but it must nevertheless advance *pari passu* with the latter, and the unequal character of the audience to whom it is addressed involves a special difficulty for the professors much greater than may be generally supposed.

To expound the principles of descriptive geometry and of mechanics, as well as their applications, without having recourse to scientific formulæ of an order too high for the generality of the hearers; to deduce from a few general elements and observed facts the laws of natural phenomena, and thence infer the rational processes to be followed in the practice of the arts; to render strictly scientific instruction intelligible to the average mind in a simple manner, without using calculations or reasoning too hard to comprehend:—these are difficulties of which scientific adepts who have never made the experiment can have little conception.

To this difficulty, which certain courses can not altogether escape, must be added, at the Conservatory, that of keeping the instruction on a level with all the improvements constantly being made in science and its applications, as well in France as abroad.

The influences brought to bear on the progress of science applied to industry by the Imperial Conservatory of Arts and Trades may thus be summarized:—

Collections of models, machines, and products.

Lectures on science applied to the arts and to industry.

Appliances for experimenting.

A library, composed of 18,000 volumes on science and industrial art. A gallery of designs placed at the disposal of the public for taking copies.

An elementary school, which would become far more useful if transformed into a special high school of art applied to industry.

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## IMPERIAL SCHOOLS OF ARTS AND TRADES.

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### HISTORICAL SUMMARY.\*

IN the year 1802, there were three Government colleges, which formed what was called the *French prytaneum*. These colleges were situated at Paris, (*Louis-le-Grand*), Saint-Cyr, and at Compiègne. In these establishments, which were under military discipline, the pupils were taught French, the classical languages, ancient history, geography, drawing of the figure, and mathematics. Most of them were educated at the public expense.

One day, the Emperor, while still First Consul, paid a visit to the college at Compiègne and questioned some of the elder pupils as to what they intended to do on leaving the college. He was much dissatisfied with their answers. "The Government," said he, "pays considerable sums to educate these young men, and when their studies are ended, none of them, except those who enter the army, are of any use to the country. Nearly all of them remain at home, a burden to their families, which they ought to aid. This shall continue no longer. I have just visited the great manufacturing establishments in the north and the larger workshops of Paris. I every where found foremen clever in the manual labor of their trades, but scarcely one among them able to draw the outlines or make the most simple calculations of a machine to convey his ideas by a sketch or a written description. This is a great defect, and I will here provide the means for remedying it. There must be no more Latin here; that will be learned in the lyceums about to be organized; but the study of trades, with so much theory as is necessary for their progress; by this course we shall obtain well-taught foremen for our manufactories."

This was the real starting-point and the object of the Schools of Arts and Trades. A few days later the *Moniteur* published the following decision, (25th February, 1803:)<sup>†</sup> "From and after the

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\* Compiled from Report of the Inspector, M. Le Brun.

† A few months later, the Paris section (*Louis-le-Grand*) was transformed into a lyceum on the creation of these new colleges, and by a decree of the 15th Vendémiaire, year XII, (1804,) the college of Saint-Cyr (removed to La Flèche) was alone to bear the name of *French prytaneum*.

month of Germinal, year XI, the teaching in the College of Compiègne shall have for its object the training of workmen and managers of workshops."

The pupils under twelve years of age were divided into three classes, in which they received an elementary education:—1. Reading, writing, and the rudiments of French grammar. 2. Continuation of the same studies, with the four rules of arithmetic. 3. The same studies, with the elements of geometry and first principles of drawing. From this college the pupils passed to the School of Arts and Trades, where, according to the occupations which they were to pursue, and qualifications, they were distributed among the different workshops, as,—1. Smiths, filers, fitters, turners in metal. 2. Founders. 3. Carpenters, joiners for buildings, furniture, and machines. 4. Turners in wood. 5. Wheelwrights. In these shops they worked eight hours a day. There were six classes, according to the proficiency and aptitude of the pupils. Only two hours per day were devoted to study and to theory, including geometry, descriptive geometry applied to the arts, drawing and tinting of plans and machines. It was also arranged that those who should make great progress and display extraordinary talents should receive a more advanced education. They were to continue the same studies, and were also to be instructed in the application of the principles of mechanics to the practice of the industrial arts.

Such, as regards both theory and practice, was the system of instruction at the College of Compiègne, which, at the close of the same year, assumed the name of *School of Arts and Trades*. Pupils were admitted at any age,\* and at all times of the year. The number was fixed at 500. The Emperor, when hunting in the Forest of Compiègne, was very fond of visiting the school, and entering into familiar conversation with the pupils.

By an imperial decree of the 5th September, 1806, the School of Arts and Trades was removed to Châlons-sur-Marne.

That same year the Duke de la Rochefoucauld,† who had been

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\* During the year several notices were inserted in the *Moniteur*, granting scholarships in the College of Compiègne to the children of parents who had died in the army or other branches of the public service. There was a class or category of very young children, whose management was confided to a lady-governess. In virtue of a decree of the 16th Frimaire, (7th December, 1805,) which adopted the children of the generals, officers, and soldiers who fell at the battle of Austerlitz, even children at the breast, with their nurses, were sent to Compiègne.

† The Duke de la Rochefoucauld had founded at his farm of La Montagne, near Liancourt, a small school for the children of his regiment of dragoons, whom he could not, owing to the regulations, get admitted as "children of the regiment." This school was afterwards enlarged to receive children from regiments whose colonels were friends of the Duke.

Two non-commissioned officers taught the children reading, writing, and arithmetic. Those who wished were also taught trades that might be useful in the regiments, such as tailoring and



repeatedly requested by the Minister of the Interior to visit and inspect the School of Compiègne, accepted the duty of inspecting the school transferred to Châlons, and presided at the distribution of prizes there. "He reminded the pupils," says the official journal, "that the idea of the establishment was entirely due to the genius of His Majesty; that the Emperor, in adopting them as his children, had rewarded in their persons the services rendered by their fathers; he enumerated all the advantages of the institution; he expatiated on the abundant sources of knowledge offered them by the school—geometry, physics, chemistry, and, above all, mechanics, that daughter of the other sciences, which would some day assure them a social position and open to them an honorable and useful career."

I will not here mention in detail all the classes and workshops for which prizes were then distributed; it will suffice to say what they were in 1812, after many modifications, and what prizes were awarded in that year by the Inspector-General:—

	Prizes.		Prizes.
Forging,.....	2	Cabinet work,†.....	2
Fitting, .....	2	Wood-turning, .....	1
Mathematical instruments,*.....	2	Lock making, .....	1
Compass-makers, .....	1		

shoemaking. This school contained nearly 80 pupils (in 1791) when the Revolution came. The Duke was soon afterwards obliged to leave his country, and his property was confiscated. The Government of the day then established, in the Duke's country seat at Liancourt, a new military school, of which his little school was, as it were, the nucleus. The schools of Popincourt, St. Martin, &c., were removed to the same place. The establishment thus formed was at first much neglected, but was afterwards better cared for and enlarged. When the School of Mars was suppressed on the 25th July, 1794, those of its pupils who chose were sent hither, and their costume was subsequently adopted for the whole school.

On the 8th Germinal, year IV, (29th March, 1796,) being the *Fête de la Jeunesse*, there was a distribution of prizes at the National School of Liancourt, and the director, M. Crouzet, then stated that the pupils were divided into the following classes:—1. Mathematics. 2. Drawing and fortification. 3. French grammar. 4. Writing. 5. Music. 6. Reading (1st division.) 7. Reading (2d division) 8. Tactics or military exercises. 9. Trades.

The Duke de la Rochefoucauld, having been allowed to return to France some days after the 18th Brumaire, was almost immediately, in honor of his philanthropy and noble qualities, restored to the possession of his Liancourt estate, which had not been sold, owing to the presence of the school. This last was then removed to Compiègne, about eight leagues distant. At the request of the Minister of the Interior, the Duke consented to pay a visit of inspection to the school at Compiègne, and continued his visits till it was removed to Châlons. Notwithstanding the distance he still performed the same functions, and was appointed Inspector-General, but without a salary, accepting only his traveling expenscs. He held this office till his dismissal in 1821, taking great interest in the prosperity of the schools, and also exerting himself to find situations for the boys when their education was finished.

The Duke de la Rochefoucauld was not the founder of the Schools of Arts and Trades, but he was at least their benefactor and protector, and he may almost be regarded as one of the founders, as his little school at the farm of *La Montagne* led to the establishment of that at Liancourt.

\* Including philosophical instruments.

† The school made furniture for the Crown until 1841 or 1842. This workshop also executed a good part of the furniture for which a gold medal was awarded in the Exhibition of 1824. On that occasion, Louis XVIII highly commended a flower-stand, with gilt bronze ornaments, which were also cast at the school.

	Prizes.		Prizes.
Wheelwrights' work,*	2	Founding,†	1
Clock-making,‡	1	Chasing,§	1
Joiners' work,	2	File-making,	1

There was also at Châlons, until 1814 or 1815, a small spinning-mill, worked by a water-wheel. When this was suppressed, the director of the workshops took the machinery on his own account, put it upon the school premises, and worked it by horse-power, ten or twelve of the pupils successively minding the spinning, but it was not kept up long. The course of instruction was arranged as follows:

Mathematics.	1st Section.—1. Descriptive geometry,	1 prize.
	2. Statics, three series or classes,	3 prizes.
	2d Section.—Elementary mathematics, three series or classes,	3 prizes.
Grammar.	1st Division,	2 prizes.
	2d Division,	1 prize.
Drawing.	Of the figure,	2 prizes and 1 grand prize for drawing from the round.
	Elements,	2 prizes.
	Tinting,	2 prizes, and 1 grand prize for drawing machines.

This system of work in the workshops and the school fitted them to become foremen and overseers in the trades they had learned at school: and the higher theoretical instruction given to the more talented pupils allowed them to promote the progress of the manufactures to which they devoted their attention.

But it will perhaps be asked how could it lead to progress in the arts of the cabinet-maker, the wheelwright, the chaser, and the locksmith, or, indeed, of the filemaker? One must remember the state of industry at that time and the ignorance of artisans in general, and it will be seen that drawing might be of some use even to the four trades just mentioned. Even the apprenticeship to file-cutting was not then so very ridiculous, as in the very same year 1812, we find the Sub-Prefect of Beaupréau, at the first distribution of prizes to the pupils of the school there, complimenting them on having supplied the country with new and improved tools, and *especially with better files for the use of locksmiths.*

The school, which had also its workshops, was still improving its organization when, on Napoleon's return from Elba, the insurrection in La Vendée compelled its removal to Angers, where it has remained ever since.

The Restoration still maintained the Schools of Arts and Trades. A royal decree of the 26th April, 1817, orders the continuation of the schools of Châlons and Angers, "both on account of the object they have in view, that of training overseers and workmen skilled

\* A considerable number of baggage and ammunition wagons were made for the army in the late wars of the Empire.

† Town and church clocks, which were much esteemed.

‡ For ordinary iron castings and bronze ornaments.

§ Modeling of the figure and of ornaments, (continued till 1841,) chasing and gilding. Until 1843 there was a master for modeling, and many pupils attended his lessons voluntarily.



in the practice of the industrial arts, and for their organization. The workshops of different kinds are to be kept in active operation. Drawing, and the elements of theoretical knowledge applicable to the arts are still to be taught there. The number of pupils kept, wholly or in part, at the expense of the State is fixed at five hundred, of whom three-fifths are entirely gratuitous, one-fifth pay a quarter of the school charge, and the other fifth one-half."

A royal decree of the 31st December, 1826, completely changed the organization of the schools, bringing them up to the level of present progress, and giving them facilities for adopting further improvements. The following is a brief abstract of the more important regulations:—

The course of instruction shall henceforth be limited to four years. Pupils are to be admitted only once a year, and after examination.

Candidates must be able to read and to write correctly, and to know the four first rules of arithmetic.

Candidates must be thirteen years of age, and not above seventeen. Every department retains its right to send three exhibitioners; one without any charge, the second to pay one-fourth of the charges, and the third one-half. The Society of Encouragement also retains its privileges in this respect. The number of pupils is limited to 600, of whom 400 are to be at Châlons, and 200 at Angers. Two-thirds of every day are to be devoted to practice, and one-third to theory. The trades taught are those of the wheelwright, carpenter, and joiner; blacksmith, filer, fitter, turner in wood, turner in metals; molders, iron-founder, brass-founder.

The theoretical studies are in the first year: writing, French, grammar, and arithmetic. The following years: geometry, and trigonometry; descriptive geometry with its various applications; the elements of physics and chemistry applied to industry, and the mode of ascertaining the strength and resistance of building materials. Those pupils whom the board considered worthy were allowed a fifth year of study.\* Ten pupils of the last class might be placed out as apprentices at the expense of the State in large manufactories, to complete their instruction. Figure-drawing is suppressed, but the drawing of machines and ornaments as well as tinting is continued.

Important changes were effected by a royal decree of the 23d September, 1832, which established the school very nearly on the same footing as at present. There was no alteration made as to the number of pupils, (600,) in the school charges, (1,500 fr. a year,) in the age of admission, (14 to 17,) or in the exhibitions.

The labor in the workshops was confined to founding in iron and brass; turning in wood, and pattern-making for castings and parts of machines; forging in the rough, and fitting and putting together of machines. A board of examination for admission is named in each department of France, and the examinations take place simultaneously in August. The programme of admission received one

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\* This supplementary year, revived in 1848, as well as the apprenticeship at the public expense, has not been very successful. The pupils have derived but little advantage from it. Those who, at rare intervals, still apply for it, seldom complete their year, notwithstanding the advantage of instruction in one or more workshops. As a general rule those pupils do best who follow the ordinary course and work for their living as soon as their apprenticeship is completed.



addition, which is, that the candidate must have served a year's apprenticeship to one of the trades taught at the school. The departmental scholarships were granted by order of merit on the list of each department. The board places those candidates first whose acquirements are not limited merely to reading, writing, and the first four rules of arithmetic. Seventy-five certificates entitling the holder to a reduction of one-fourth of school charges, were to be divided among the department, as an encouragement to the pupils, according to the place they obtain on the list of the school, (two-thirds for Châlons and one-third for Angers.) The workshop prizes, founded in 1825 by a legacy producing 3,000 frs. a year, bequeathed by Mme. Leprince, were confirmed. The length of the studies was reduced to three years, while the theoretical studies remained nearly as they were. Examinations for classing the pupils according to their proficiency must be held twice a year in each school, and prizes are given at the close of the year; those for the pupils about to leave the school are silver medals. Pecuniary encouragements were also awarded to such pupils as the minister might think deserving, but they were not to be given till the next year, and on the production of certificates, showing that the holder is following his trade, and stating the position he occupies. The prizes of the Government were not given to pupils for their progress in any special branch, but for general proficiency in all the subjects taught at the school. A standard number of marks for each subject according to its importance was established. Manual labor was to be taken into account as well as the theoretical studies and drawing.

But to permit of this extension of practical instruction, suitable workshops were necessary. They were accordingly undertaken at the expense of the schools, first at Châlons in 1838, by M. Vincent, the director, who gave the first impulse, (at the risk of leaving his successor some little financial embarrassment.) They were commenced somewhat later at Angers, (when M. Dauban was director,) and the number of pupils there was then increased to 300. Subsequently the Government intervened, and the works were pushed on rapidly, and on a scale sufficiently extensive to meet all requirements, at least for the time.

In 1841 the two schools were placed on a footing of perfect equality as to the number of pupils, which was fixed at 300 for each. But as this number soon became insufficient, it was considered desirable to found a third school. As the first two schools were in the north and centre of France, the Government decided on having the third in the south. It was first thought of choosing Toulouse



for its site, to which town it had been proposed, in 1823, to remove the Châlons school, but the preference was ultimately given to Aix in Provence, within easy distance of Marseilles and Toulon. This third school was established on the same footing as the other two, with 300 pupils, and the same studies both theoretical and practical.

After February, 1848, the schools were nominally submitted to military discipline; the first division was exercised in musket drill, but only during play-hours. In October, however, the arms were withdrawn, and the usual studies were continued with great ardor, as before. During this same year the inspection was confided to General (then Colonel) Morin, who introduced some very beneficial modifications in the courses and the drawing-lessons.

In the programme of the mathematical courses, the most important addition was that to the course of industrial mechanics, which, taking advantage of the improvements effected by General Morin himself in that science as first taught by General Poncelet in lectures to the workmen of Metz, became more practically useful and embraced a wider field. The course was terminated by dynamometrical experiments, made in the presence of the pupils, with regard to traction and the work of machines. The use of the sliding rule was introduced in the three divisions. Drawing of details of machines were made from models obtained from the workshops of the best mechanical engineers in Paris, all in linear drawing, as in actual practice. The tinted drawings of the third year were made on improved systems. The making of projects of factories and of important machines was abandoned and replaced by drawings of machines with detailed calculations of the principal parts. To teach plan-drawing, practical progressive exercises were performed every year by the pupils.

The decree of the 19th December, 1848, sanctioned the existence of the schools, their mode of instruction and their organization, as well as the various exhibitions given by the Government. It also regulated the conditions of admission and the boards charged with the examinations in each department. It further confirmed the minimum of age, which for some years past had been fixed at 15, experience-having proved that boys of 14 were not sufficiently developed to bear the bodily and mental fatigue of going through the whole course of instruction in three years. The qualifications for admission, which, considering the minimum of age, (now raised to 15,) and the progress of primary instruction, were by no means a proof of capacity, (reading, writing, and the first four rules of arithmetic,) were altered so as to become a real test of the capacity of



candidates. These qualifications were henceforth to be : reading, writing, orthography, practice and demonstration of the first four rules of arithmetic, fractions, and the decimal system ; geometry, so far as regards plane surfaces.

In addition also to the oral examination, there were introduced : problems in arithmetic and geometry from dictation ; linear drawing or drawing of ornaments ; and an exercise in the manual labor of the trade to be learned, performed in the presence of a practical man. As already stated, the duration of the studies was fixed at three years, but a fourth year for improvement was allowed, as a recompense to ten pupils in each school, chosen from those who had obtained a workshop prize, or one of the fifteen medals. The rewards in medals and money prizes were maintained, as well as the workshop prize founded by Mme. Leprince for Châlons and Angers.

Thus in the progress of fifty years, the schools founded to train educated workmen and overseers in the industrial arts, and also, at first, to bring up the orphans of soldiers in a trade by which they might get a living, have been successively modified so as to keep pace with the progress and development which time has wrought in industry. They have advanced in theory and practice as occasion requires, and have at last come to be more especially applied to general mechanical industry, for which theoretical knowledge is indispensable.

#### PRESENT ORGANIZATION.

The pupils are admitted after examination, and once a year only, on the 1st of October. The instruction extends over three years. Sunday is the only day of rest ; there is no holiday or half-holiday on Thursday. There is no time lost ; and the pupils are accustomed to the life of the workshop, by being fully occupied six days per week from the time of entering the school. Five hours and a half are devoted to theoretical study and seven hours to practical work ; in all twelve hours and a half.

The theoretical study is divided into two parts, four hours and a quarter in the morning and one hour and a quarter in the evening. The early part of the day, when the head and ideas are fresh, is chosen for the mathematical lectures and interrogations, and also for drawing. There is little study, properly so called, in this portion of the day. The evening sitting is more especially employed in study. The grammar and writing-classes are interposed between the two sittings, so as to make the best use of the time. The practice in the workshop is divided into two equal portions (from ten to half-past two and from half-past three to seven,) separated by the dinner and the playtime after it. This interruption of the manual labor rests the body, as the work itself rests the mind for the evening studies. The pupils rise at a quarter past five and make their own beds.

The whole school is divided into three classes (or years of study,) each having its own professor of mathematics or mechanics and of drawing. There is also a professor of grammar for the three divisions, and a professor of writing for the first two years only. The chaplain, in addition to the performance of divine service, gives a lecture every week in religious and moral instruction.

I have heard persons dispute the utility of the grammar and writing-lessons



for our pupils, who ought to know those branches when admitted. But does not the orthography of school-boys require to be kept up by practice, and are they all adepts in spelling? As for writing they acquire a better hand at school, and in the last half of the second year they have to practice industrial book-keeping. The progress made in these two branches proves their utility.

In *mathematics* the professors go straight to the object in view, without noticing any of the subtleties of the science. But numerous applications exercise the pupils' minds and fix the principles in the memory by showing their utility. In the interrogations the boys are stimulated to answer promptly.

Bobillier's geometry, composed expressly for our school, is essentially simple and precise; for descriptive geometry we follow Theodore Oliver's method and notation; for mechanics the spirit and method of the course of MM. Morin and Tresca, abridged.

In the first year the professor goes rapidly through the programme of admission, thus systematizing the different methods learned elsewhere before proceeding with the same subject. He follows his pupils through the two years of mathematics proper, during which he teaches them: arithmetic, algebra, as far as and including quadratic equations, elementary geometry, comprising curves of the second degree demonstrated geometrically, plane trigonometry, the elements of descriptive geometry and cinematics or geometrical mechanics.

In the third year a professor teaches industrial mechanics, including hydraulic machines and steam-engines; of physics, the principal general elements, and in considerable detail; lastly a few elements of chemistry, the nomenclature, and what bears more especially on materials. Numerous practical applications varied for each pupil exercise the pupils in mechanics. The repetitions or interrogations are made by the professors and by the foremen of the workshop.

*Drawing* is taught very simply. In the first year the pupils, to get the free use of their hand, make designs with the drawing pen, comprising all the principles of symmetry, of joining curves, &c., which they will require later when they come to draw machines. Most of these exercises are taken from architecture, of which the pupils also learn some of the elements. For this part only, the drawings are copied from models. Geometrical drawings, designs of joints in carpentry and joinery, elementary exercises in drawings tinted with Indian ink and dull colors, as well as two drawings of plans, complete the first year's studies.

In the second year, first the elements of machine drawing; next come, in the hours of study, working-drawings of descriptive geometry, which require the most rigorous accuracy. On reaching this point the pupils have acquired neatness, clearness, accuracy, and precision, and should be able to draw well. They immediately apply these principles to the geometrical drawing of machines, of gearing, &c. In this second year, the pupils in the workshops, in their drawing-lessons, make sketches of tools and various machines to scale, with dimensions given. In the third year they make drawings of machines and those relative to the lectures on mechanics. They also calculate the principal parts of the machines they represent. They conclude with making drawings of machines in plain tints.

I have been thus particular respecting the drawing in order to show that this graduated method is at once simple and natural. The complete course of drawing in the three years comprises from 100 to 110 designs or working-drawings. The professors of drawing also teach by a few progressive lessons every year, the principles of topography. These same professors execute, in the office of the engineer of the works, the projects and details of machines to be constructed in the workshops. Convalescent pupils, after hurts or illness, take part in these designs during the workshop hours.

#### PRACTICAL INSTRUCTION.

One-third of the pupils are distributed in the preparatory workshops, that is from 25 to 35 pupils in each of the three: the pattern-shop, the foundry, and the smithy. The remaining two-thirds, amounting to about 200, work in the fitting shop.

*The Pattern Shop.*—The pupils begin with making simple patterns with



boards, then each learns to execute all the different joints used by carpenters and joiners; next come patterns for founders (proceeding to the most complicated and most difficult,) gearing (straight or beveled, with or without mortising,) cylinders, and framework for steam-engines, &c. The pupils also make, but only as exercises in the handling and cutting of wood, and according to the demands of the country, articles of furniture, wood-work for churches, pulpits, &c., more or less ornamented.

*The Smithy.*—They begin with welding scraps of old iron into masses, and making tongs and other tools used in forging; they next forge small articles for exercise in filing and fitting, and then parts of machines, from the simplest to the most complicated. In the third year the pupils learn to use the steam hammer.

*The Foundry.*—They begin with plain castings of balustrades, palisades, medallions, and the simpler parts of machines; and then as an exercise, in detached ornaments, before executing them on a large scale, the pupils make small busts, statuettes, &c. As a general rule in this workshop, as in the fitting room, and at the forge, they begin with practice entailing but little expense of material. By degrees they come to the framework of machines, and the casting of large wheels, either with cogs or with mortise holes to receive wooden cogs; and, lastly, to the casting of steam-cylinders, &c., according to the orders to be executed. More carefully executed statuettes of a larger size, Joan of Arc, La Tour d'Auvergne, the Magdalen, &c., give them some idea of artistic molding which the school of foundry does not indeed profess to undertake, though such castings have occasionally been made there.\* Most of the statuettes are executed in ordinary cast iron, and therefore cannot be ornamented with the chisel. All the operations of the workshop are performed by the pupils themselves, as making the molds, charging the furnace, working the cranes, casting, paring, and trimming.

*The Fitting Shop.*—The pupils begin with simple pieces of regular forms, requiring great attention to symmetry and precision, and for that reason very instructive. For instance they first make two small iron straightedges perfectly true in every sense, then two squares accurate in every respect; next with a piece of wrought iron, they make a regular quadrangular prism, and from it an octagonal prism; or a right cylinder, to be afterwards turned into a hexagonal prism, &c. After this they make various kinds of compasses, hand and claw vices, keys for screws, ratchets, &c., then bow-lathes, bench-vices, pulleys, and lastly, all the different parts of machines, according to orders on hand, machine tools, steam-engines, &c.

The general principles are:—1. To make, as a general rule, only one piece of the same kind, in order to know how to execute the greatest possible number. 2. To do all work, as far as practicable, by hand, and with the simplest tools.

The object is not to get as much money as possible by making the same thing over and over again, but to learn how to work well at all kinds of things, so that the pupil may be able to turn his hand to any branch of his trade where he may find an opening, and to fit him for entering any workshop, large or small, with a good store of practical knowledge. After one year's work, at most, in any specialty, a clever pupil will acquire all the rapidity of execution common to good workmen.

The machine tools, planing, mortising, and filing machines, are seldom used by the pupils till they can work well with the hand; but the less skillful always have the advantage of seeing these machines in use and having been obliged to make drawings of them must be well acquainted with their principles. Each pupil has a vice to himself, and at each bench there are pupils of all the three divisions, that the more advanced may teach the juniors. There are also in each shop one or two workmen as examples for the boys, and they are also employed when required to put up the machines made at the school for private manufacturers.

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\* The school of Angers cast, on the 10th August, 1861, the bronze statue of the Duke de la Rochefoucauld, which has been erected in the public square at Liancourt. This statue, 2 m. 80 c. (9 ft. 2 in.) in height, modeled by Mandron, the well-known sculptor, (himself a pupil of the school of Angers,) was cast in one piece with the most complete success, by M. Biesse, the manager of the foundry, and a pupil of the school.



*Classification.*

The classing of the pupils according to merit, which, as already stated, takes place twice a year, is decided according to the entirety of the studies, theoretical and practical, and the same number of marks is allowed for the practical part as for all the theoretical studies. The classification made at the end of the year is followed by a distribution of prizes to the most deserving. These prizes, for the second and third divisions, consist of books on science or industrial art which may be useful to the pupil for his studies or after leaving the school. For the first division (the pupils who are about to leave) the prizes are silver medals, bearing the words: *School of Arts and Trades—Reward*, and the pupil's name engraved.

The maximum of medals is fifteen for each school. A sum of money is sometimes added to give the pupil a start in life, but this is never paid till the following year, and then only on condition of the claimant's producing certificates that he has been working at his trade for the past twelve months. Each first workshop in the schools of Châlons and Angers receives, provided it attains the required standard of merit, the prize founded by Mme. Leprince, amounting to one-eighth of 3,000 fr., or 375 fr. for each.

At Châlons also, ever since 1863, there have been awarded three prizes of honor, founded by M. Xavier Jourdain, manufacturer, of Altkirch, as a testimonial of his gratitude for the education he received at the school, to which he attributes most of his success in life.\* The first prize is a gold medal worth 300 frs., and a sum of 1,000 frs.; the second a similar medal, and 500 frs.; and the third, a silver medal, with 400 frs. These prizes are awarded to three pupils chosen from among the first fifteen on the list, regard being had to both study and moral conduct.

*Expenses, &c.*—Each school has an annual grant with which it must meet all the expenditure, not only for the teaching staff and management, for the board and other outlay on account of the pupils, but also for materials and tools for the workshops, for the clothing of the pupils, and for the repairs of the buildings. The school has nothing beyond this grant. The receipts for the board of pupils, and for clothes, as well as the proceeds of the sale of things manufactured in the workshops, belong to the State.

These schools receive every year from 300 to 315 pupils—selected by open competition, in which at least 1,500 candidates engage—showing that admittance is eagerly and widely sought for.

Immediately on leaving the school, the pupils find remunerative employment in factories, workshops, railway establishments, on bridges and roads, in the navy and navigation companies, as foremen, overseers, molders, pattern-designers, surveyors, engineers, and other useful and responsible positions.

Out of 465 pupils who left the schools in 1861 and 1862, 188 within twelve months afterwards were at the head of large establishments, or chiefs of workshops; 165 were pattern-designers for manufacturers or draughtsmen for railways; 47 were engineers in the imperial navy; 22 were road and land surveyors, and only 2 were unemployed.

Important as these schools are to the public service, and to great national industries, the international exhibitions of London and Paris satisfied the government that “in the same as well as in other

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\* M. Xavier Jourdain has also founded three scholarships at Châlons for boys of his native place.

directions, additional efforts must be put forth to maintain French industry at the level which it has reached, and enable it to meet the rivalry of other countries in fields once by universal confession exclusively her own."

We give below a list of the officers and instructors of one of the provincial Schools of Arts and Trades together with the salaries paid to each.

Officials.	Salaries.			Observations.
	On entering.	After 5 years.	After 10 years.	
	francs.	francs.	francs.	
1 Director, . . . . .	5,000	5,500	6,000	
1 Engineer of Works, . . . . .	3,000	3,500	4,000	
1 Treasurer, . . . . .	2,200	2,500	2,800	
1 House Steward, . . . . .	1,700	2,000	2,000	
1 Chaplain, (Catholic), . . . . .	2,000	2,000	2,000	Including 300 fr. for a lodging.
1 Professor of Mechanics, . . . . .	2,000	2,500	3,000	
2 Professor of Mathematics, . . . . .	2,000	2,300	2,500	
3 Professor of Drawing, . . . . .	2,000	2,300	2,500	
1 Professor of Grammar, . . . . .	1,400	1,800	2,000	If librarian, 400 fr. in addition.
1 Professor of Writing, . . . . .	1,200	1,400	1,700	Professes industrial book-keeping.
1 Overseer of fitting workshop, . . . . .	2,000	2,500	3,000	
3 Other Overseers, . . . . .	2,000	2,300	2,600	
5 Foremen fitters, . . . . .	1,700	1,900	2,000	The foremen hearing repetitions receive an indemnity of 250 fr. [fr. In all (10 years) 2,250
3 Foremen for the three other workshops, . . . . .	1,700	1,900	2,000	
1 Adjutant of 1st class, . . . . .	2,200	2,200	2,200	
If of 2d class, . . . . .	1,300	1,300	1,300	With clothes and board.
1 Director's Secretary, . . . . .	1,700	2,000		
1 Store-keeper, . . . . .	1,600	2,000		
2 Book-keepers, . . . . .	1,400	1,700		
8 Adjutants, one of whom is infirmary wardsman, . . . . .	700	900	—	With clothes and board.

The number of hours devoted by each to their respective duties are as follows:—

Director, his whole time, and the engineer nearly the whole; treasurer, seven or eight hours per day; house-steward, nearly the whole day; professors of mechanics and of mathematics, during ten months or ten and a-half, six days per week, from two and a-half to three hours of lessons and interrogations, without counting the revision of tasks and time for preparing their lectures at home; professors of grammar and of writing, about the same; professors of drawing, from five to six hours in lessons, or in making drawings for the engineer or the workshops; overseers, eight or nine hours daily; foremen, eight or ten hours daily, including the repetitions; book-keepers, seven or eight hours a day, (generally seven.)



# IMPERIAL CENTRAL SCHOOL OF ARTS AND MANUFACTURES,

AT PARIS.

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## HISTORICAL DEVELOPMENT.

THE Central School of Arts (*Ecole Centrale*) at Paris grew out of the necessities of national industry, although its early projectors and teachers were in no way connected with the government, or interested directly in any of the arts or trades which its success has greatly promoted. Satisfied from the example of the Polytechnic, and the Government Schools of Mines and Mining, of Civil Engineering, and the Military and Naval Schools, that a course of instruction at once scientific and practical, designed to train engineers, architects, and constructors of works, not governmental or public, machinists, and technological chemists, and foremen of industrial establishments generally, Messrs. Dumas, Péclet, and Ollivier, with whom was afterwards associated Lavallée, undertook the enterprise, and commenced their lectures and demonstrations in 1829. With an equipment of lecture-rooms, laboratories, collections of machines and models, and other facilities for demonstrations and manipulations, which would now be thought utterly inadequate, the school was from the start an assured success, both as an investment of the time and means of its projectors, and in the demand for its instruction by young men aspiring to qualify themselves for responsible positions. Its diploma or certificate of competency became at once the guarantee of immediate and profitable employment at home and abroad, and its reputation and its advantages became not only national but international. Its students come from the provinces as well as from the capital; and at all times there are representatives from abroad. Out of 4,560 pupils admitted up to Jan., 1864, one-fourth (1,114) were foreigners. In 1833 the government recognized its public usefulness by taking its examinations under the inspection of the Minister of Commerce and Public Works; in 1838 by establishing annual stipends to the value of \$6,000 for the benefit of diligent pupils from Paris or the provinces; and in 1857 by assuming the whole charge of the institution, with the consent and under an agreement with its original projectors and proprietors. We give an account of the school as it was in 1836 and 1867.



The money was granted by the Minister in 1838, and in 1842 it appears that nineteen of the *Councils Généraux* in different departments in France voted funds to send up to this college a certain number of young men from their towns; and the Minister had, it seems, provided for forty, whose previous instruction and good conduct, and the positions of their families, has entitled them to the favor of the State.

The STUDENTS of the establishment are of three classes—viz., those who are brought up by the State; those for whom funds have been voted by the Councils General of departments; and those received at the expense of their families.

IN ORDER TO OBTAIN ADMISSION, Government and departmental candidates are examined at Paris, before a jury named by the Minister of Commerce for this purpose each year. The candidates must have been registered and recommended by the department whence they come; and they must prove that they are between the ages of eighteen and twenty-one. They undergo two examinations—one oral, the other written; and they must solve with ease certain problems in elementary mathematics and geometry. They must write and describe their problems and theories well; draw by rule and compass; sketch and color. Without these qualifications it is impossible to be admitted as a Government student, and the juries are instructed to select those who shew most literary attainments, and who “appear to have that deception of intelligence which promises an aptitude for industrial science, rather than mathematical acquirements.” A great preference is given to those who have obtained the necessary qualification in a high degree, and whose means are limited, and the administration is not to aid those whose families are in a position to defray the expenses of their education. All students may participate in an “Encouragement Fund” for the first year, but afterwards only those who shew the greatest amount of merit; and an augmentation may be accorded to those who are remarkable for still higher qualities. PRIVATE STUDENTS are admitted at any age above sixteen. They, too, submit to both oral and written examinations. They must execute certain problems, and write clearly and correctly the theories as set forth in the programme. Foreigners as well as French students are admitted, provided they can write and read the language. In Paris, these examinations are made by a board named yearly by the Council of Studies, in the departments by public professors of mathematics, and in foreign countries by the university professors; and all applicants must produce proper testimonials as to their morality.

The AUTHORITY OF THE SCHOOL is vested in a director and a Council of Studies, consisting of nine professors. The director lives in the college, and is charged with its administration and correspondence, but he can not appoint professors; these are selected for their practical as well as theoretical experience. The Council admit or reject candidates after reading the statement of their examinations, and they report on the progress of each student—as to his aptitude and capabilities, and whether he is eligible to be transferred to a superior division, or whether his friends shall be requested to remove him. The students bind themselves by a solemn declaration to take no part in any conspiracy to oppose the execution of the decisions of their superiors, and they promise to enter into no coalition for imposing on the junior or senior branches of the college. No students are lodged within the college, and they are not permitted to wear any description of uniform.

The COURSE OF INSTRUCTION is limited to three years, during which period it is obligatory. It includes lectures, daily examinations, drawing and graphic exercises, chemical manipulations, working in stone and wood, physics and mechanics, the construction of buildings and other works, and general annual examinations. The students are, in addition, expected to make notes and reports, and to visit the workshops and manufactories. They are boarded and lodged at respectable houses in the immediate vicinity, at their own expense. Each year there are general examinations in every branch of science and art. In the middle of the second year the studies are subdivided—one course is general, the other has special relation to the ultimate destination of the scholar.

The specialities are four in number:—1. Mechanics. 2. Constructors, as architects, engineers. 3. Mining and metallurgy. 4. Chemistry, applied in all



its branches, including agriculture. After that period, the whole energies of the student are devoted to those branches of science on which the profession he is about to adopt depends.

With respect to **DIPLOMAS** and **CERTIFICATES**, the students of the third year are admitted to competition for diplomas, a programme of examination being made out for each speciality. The competitors are allowed thirty-five days within the college to make out their designs and compose their memoir, and then they are examined by five professors in public and before the students of two years. After the examination, the professors in council grant diplomas to those who have excelled and who have passed with the greatest honors, and "certificates of capacity" to those who have given less general proof of the highest talent. At each examination those who do not advance sufficiently, or are idle, are recommended to retire. All the examinations are kept for reference in the archives of the college.

The **FEES FOR EACH STUDENT**, including several extras, are altogether 870 francs (\$174) per annum. That the institution is flourishing, is proved by its being mainly self-supporting; and that the country benefits by it, the long array of eminent graduates who might be named together with a statement of their present employments, would most satisfactorily illustrate.

The following is the programme of instruction somewhat more in detail :

#### FIRST YEAR.

*Descriptive Geometry.* Theory and application to perspective, drawing, and shading; stone-cutting—details; carpentry—details.

*Analytical Geometry and Mechanics generally.* Theory of motion and equilibrium of forces; velocity, acceleration, force, mass; general principles of motion, gravity, power, effect; statics of solid bodies.

*Construction of Machines.*

*Transformation and Modification of Motion.*

*Physics generally.* Laws of gravity, balances, pendulum, and its application; hydrostatics, hydrodynamics, heat, magnetism, electricity, electro-dynamics and electro-magnetism, molecular action, acoustics, light, optics.

For the first year the students are made to manipulate, in determining the density of solids, liquids, and gasses, the construction and use of barometers, thermometers, and hygrometers; determination of refractive powers, photometers; power of rotation in liquids, saccharometers.

*Chemistry generally.* Minerals, and the study of all objects not metallic; the atmosphere, gasses. Metallic; general methods for extraction of metallic oxides; general properties of sulphurets, chlorides, &c.; general properties of the salts; metals useful either alone or in their combination for the arts.

*Organic chemistry.* Methods of analysis; principal organic products; their uses in the arts; acids, and their applications.

One day in the week in the laboratory, to practice the experiments they have seen in the lecture-room.

*Medicine and Natural History applied to Industry.*

*Hygeian Science and Physiology, as far as Public Health is concerned :*

*First Part.* Food, clothing; influence of heat and cold; dampness, and a dry atmosphere; sun and winds; the health in different professions; sanitary regulations and legislation.

*Second Part.—Natural History.* The animal creation in all that relates to industry, the arts and agriculture; power, produce, and nutriment. The vegetable creation; substances employed in the arts; wood, textiles, cereals, wines, tanning, dyes.

*Drawing and Design in its various Branches.* During the vacation, plans and elevations of buildings and works are executed, which must be presented at the commencement of the term.

#### SECOND YEAR.

The same as the first year, besides modeling in plaster for stone-cutting, &c.

*Industrial Physics.* Properties and construction of furnaces of all kinds for different descriptions of fuel, transmission of heat, sublimation, distillation, evaporation, heating air and liquids, refrigeration, lightning, ventilation, and sanitary arrangements of towns; constructions of all kinds in model bricks and plaster of Paris.

During the recess the students visit works and manufactories, and are obliged to present detailed reports on them.

The students of the third year complete five different projects, with drawings, calculation and estimates on which there are conferences, one on each speciality every month.

*Second and Third Year.* Applied mechanics in great detail, applied hydrodynamics, construction and setting up of machines. analytical chemistry in different branches for different professions, industrial chemistry both mineral and organic, agricultural chemistry.

*Public Works.* Roads, bridges in stone, wood, iron, and suspension; natural inland navigation, artificial inland navigation.

*Architecture.*

*Geology and Mineralogy.*

*Mining, Working, and Ventilation.* Metallurgy and fabrication in iron, steel, zinc, and copper; furnaces and founderies for all metals.

*Technology.* Manufacture of cordage; stone and wood sawing; textile manufactures in



cotton, wool, flax, silk; cotton spinning; expression of oils; grinding, felting, ceramic works, and pottery.

*Special Courses for the Third Year.* Steam-engines of all descriptions; railways and different systems for locomotion; the students visiting the most important works with their professors.

The students are examined daily upon the subjects of their lectures, by the professors and repeaters (*Répétiteurs*.) The utility of this latter class of teachers is well established in France, and they are found in every institution in which lecturing is practiced to a great extent as a means of instruction; they prevent the burthen of teaching from falling upon professors, whose duty it is to be engaged in advancing, as well as in propagating science, and who would be prevented from following one or other of these honorable and useful careers, by having the duty of teaching superadded to that of lecturing. So well is the necessity of relieving the professor understood, that in all courses requiring preparation, special persons are appointed, called preparers, who take off this burthen also from the professor. The result is, that many men of high eminence are thus enabled to diffuse their knowledge among students by lecturing, and are willing to do so, though they have other and more profitable employments, to which they would exclusively confine themselves, if this were connected with teaching by interrogation and the task of preparing experimental illustrations. The pupil is thus greatly the gainer, and has at the same time the special examination upon the lecturers which is so necessary to complete the instruction, and to which a repeater is entirely competent. Young men of talent seek the situations of repeaters as the best method of showing their particular qualifications, and the most certain road to a professorship. For each recitation the pupil receives a mark, and the roll of the class with these marks being preserved, its indications are combined with the results of the examination, to decide upon the fitness of a pupil when he comes forward for a diploma.

The graphic exercises consist in the drawing of ornamental work, in India ink drawing, in drawing with the steel pen and instruments, and in sketching the diagrams of the lectures to a scale. Great importance is attached to this part of the course, and much time spent in it. The rooms for these exercises are conveniently arranged, and the pupils are superintended during them by a professor or a repeater, and visited occasionally by the director of studies or his deputies. The drawing-tables are so arranged that the pupils stand while at work, which at their age is very desirable.

The arrangements for chemical manipulation by the students are very complete; they have access not only to the laboratories of the two professors, but to others which are devoted to special branches. During the first year every student is employed in laboratory duty once a week, and has also the opportunity of performing some of the principal physical experiments. They are superintended, while thus occupied, by repeaters. During the first half year of the second course the students are called, in turn, to general duty in the laboratory; and during the second half of the same year, and the whole of the third, the two sections who follow the courses of chemistry applied to the arts and metallurgy, are employed in manipulations connected with them. There is an officer for their superintendence, called the director (*chef*) of the chemical exercises, who is subordinate to the professor of chemical analysis. The opportunities thus afforded of acquiring a general practice under the guidance of the distinguished professors of this school are invaluable, and form one of the most important features of the establishment.

The materials for constructing models of some of the more useful works, and apparatus relating to the arts, are furnished to the pupils, and used under the direction of their instructors.

The annual number of students entering varies from 130 to 160. They work eight hours and a half in the college, and four at their residences. Four inspectors are constantly occupied in surveying, independently of those superintending the graphic department.



The Central School of Arts and Manufactures, founded in 1829 by three then youthful votaries of science, (Dumas, Pécelet, and Ollivier,) aided by M. Lavallée, who zealously coöperated in the work, plays, without parade, a most important part in the educational system of France. The following notice of its original object and results—of its historical development and present subjects and methods of instruction, is taken from a Report of the Commission on Technical Instruction to the French Ministry of Agriculture, Commerce, and Public Works, in 1864, and from the latest programme of the Institution.

In 1829, manufactures, thanks to several years of profound peace, were beginning to assume great importance in France; but to struggle against foreign competition, daily becoming more formidable, it was not enough to possess good workmen and intelligent overseers; skillful engineers were likewise wanted. The manufacturers, moreover, felt the necessity of themselves acquiring or of obtaining for their children that theoretical knowledge without which they were unable, not only to direct their establishments themselves, but also to control the managers whom they engaged for the purpose. At that time there was no school where industrial science could be acquired.

The Sorbonne, the Conservatory of Arts and Trades, the schools of Châlons and Angers, though very useful institutions, answered the purpose but very incompletely. They did not impart that accurate and profound instruction which is necessary for the directors of large manufacturing establishments and indispensable for civil engineers.

At the Sorbonne and the Conservatory the teaching is purely oral, and the fact is indisputable that such lectures are not sufficient for the training of engineers. They can only answer that purpose when accompanied by frequent examinations, numerous experiments and manipulations, graphic studies, conferences on the subjects treated in the courses, varied projects, solutions of problems performed by the pupil under the professor's eye. These various modes of teaching must be combined to obtain the best possible effect. Compare the Sorbonne with the Polytechnic School; all the courses of the latter are found in the Faculty of Sciences, and nearly-all of them are given by the same professors. Nevertheless the results of the teaching are very different in these two establishments. The Faculty of Sciences lacks those frequent examinations, those regular and methodical studies which are imposed on all the pupils of the Polytechnic School. Reduced to its lectures only, the Polytechnic School would soon lose its privilege of supplying France with men able to render the most important public services. Between the Conservatory of Arts and Trades, which is a real industrial Sorbonne, and the Central School, the same comparison may be established as between the Faculty of Sciences and the Polytechnic School.

The Schools of Arts and Trades supply our workshops with young men who promptly become excellent overseers; but the theoretical studies are not sufficient to form skillful engineers. Some few remarkable men have indeed proceeded from these schools, but they were of the sort who will learn wherever they may be, and rise to celebrity just as well from the dust and smoke of the workshop as from the benches of a school-room.

The Central School, therefore, can not be compared for the services it renders either to the Sorbonne, or to the Conservatory of Arts and Trades, or to the other technical schools. It remains to be seen whether it is not an unnecessary duplicate of its elder sister, the Polytechnic School, and this question we will now examine.

The Polytechnic School was founded at a time when political revolutions had thrown scientific studies into the background. Its object was to give those studies new life, to impart a common direction to the labors of scientific men, to concentrate on one point efforts till then unconnected; in short, to supply our corps of engineers, civil and military, with the well-taught recruits they so much needed. And it has nobly fulfilled its mission. The Schools of Mines, and of Bridges and Roads, completed the work undertaken by the Polytechnic School.

But the time required by the Polytechnic School, including the preparatory and complementary studies, is seven years, which is much too long for candidates who are anxious to begin practice as soon as possible. The difficulties of the examination for admission also exclude a large proportion of candidates; the consequence is that the number admitted every year is very limited. It shuts its doors against many hundreds of young men whose minds, though little disposed for mathematical abstractions, are none the less capable of studying the applied sciences. More than half its pupils choose the military service, and of the other half a good part soon abandon the civil services to follow scientific pursuits. The Polytechnic School is therefore far from being able to satisfy the ever-increasing demands of industry. There is good reason to fear that if the pupils of the Polytechnic School were left free to choose between the posts offered by private industry and those reserved for them by the Government, the cleverest of them would give the preference to industry, which assures them positions, if not more honorable, at least more liberally remunerated; hence might result great prejudice to the State. The Government seems to be aware of this, for it has already forbidden its engineers to serve any other companies but those for railways.

The Central School, therefore, supplies a manifest deficiency in our system of instruction. Its function is to educate our leading manufacturers, and the directors of our great industrial establishments; while the mission of the Polytechnic School is more especially to supply properly qualified recruits for the special corps. The success it obtained from the very first, a success every day increasing, sufficiently proves its immense usefulness.

Notwithstanding its high charges, and the fact that it does not, like the Polytechnic School, offer its pupils any assured position on the completion of their studies, the Central School has found, in presence of other establishments where instruction is gratuitous, the number of candidates for admission constantly increasing, and to such an extent that not more than half of them can be received. The late treaties of commerce have rendered industrial education more necessary than ever. "If the Central School did not already exist," says M. Michel Chevalier, "it would have been indispensable to found one as a necessary complement of those treaties." Moreover, it is a tradition in the school that its foundation was originated with a view to preparing French manufacturers, by a sound education, to pass without any violent shock from a system almost prohibitive to one of limited protection.



In all the branches of industry the pupils of the Central School have taken honorable positions. They stood in the first rank among the creators of railways, and some of them, notwithstanding the formidable competition of the Government engineers, still hold important positions under the great companies. At Paris the chief engineers of the rolling stock and locomotive department of four great companies (the Northern, the Orleans, the Eastern, and the Western) belong to the Central School. In the mining and metallurgical industries, in those of gas, spinning, dyeing, paper-making, plate glass manufacture, in the agricultural arts, and lastly in all the mechanical and chemical industries, we find at the head of large establishments old pupils of the Central School, who have nearly all attached their names to important improvements in the processes they were charged to conduct.

The above statement is fully proved by the following figures:—Of the 2,051 pupils who obtained, on leaving the school, the diploma of engineer or the certificate\* of capacity, we have been able to obtain precise information respecting 1,394 only. Of this last number we learn that 247 are dead, and that the 1,147 still living are distributed in different careers in the following manner:

Railways :—Directors and chief engineers, salaries from 20,000 to 70,000 fr.,....	28	} 320
Principal engineers, salaries from 10,000 to 20,000 fr.,.....	79	
Ordinary engineers, salaries from 5,000 to 10,000 fr.,.....	56	
Employed in various capacities, .....	157	
Civil engineers in general practice,.....	166	
Ironmasters, working of mines, quarries, &c.,.....	124	
Manufacturers of cloth, cotton, linen, &c.,.....	68	
Architects, .....	55	
Mechanical engineers, established, .....	54	
Spinners,.....	43	
Professors of applied sciences,.....	42	
Manufacturing chemists,.....	38	
Agriculturists, .....	37	
Contractors for public works,.....	35	
Managers of gas works, .....	31	
Sugar refiners, .....	28	
Public functionaries,.....	26	
Manufacturers of glass, porcelain, &c.,.....	23	
Engineers of bridges and roads in foreign countries,.....	22	
Paper-makers, .....	17	
Surveyors of roads,.....	17	
Total,.....	1,156	

The number of crosses and medals obtained by ex-pupils of the Central School at the great international exhibitions, is one of those facts which prove their merits better than arguments. In 1851 the Central School was too recently founded for many of its pupils to have had time to take their ranks in manufactures. The English Commission having, besides, refused rewards to assistants (*collaborateurs*,) several of the ex-pupils could not be personally named, though the establishments they managed obtained prizes. Nevertheless they received three council medals and 17 prize medals.

In 1855, at the Paris Universal Exhibition, they obtained 10 nominations in the Imperial Order of the Legion of Honor; 10 great medals of honor; 17 medals of honor; 50 first-class medals; 21 second-class medals; and 14 honorable mentions.

In 1862, the number of French exhibitors at the London Universal Exhibition was comparatively small, but the ex-pupils obtained three nominations in the Legion of Honor, one of them an officer, and 41 medals.

\* The diploma is granted to those pupils who pass every part of the examination satisfactorily; the certificates to those who answer some of the questions well, but fail in others.

In the agricultural shows of 1856 and 1860, ex-pupils of the Central School were honored with two great gold medals; three ordinary gold medals; two silver medals; four first prizes; and six prizes of the second, third, and fourth class.

The total number of ex-pupils who have obtained the decoration of the Legion of Honor, either after great exhibitions or on other occasions, is 56, of whom 52 are knights and 4 officers.

#### STUDIES AND METHODS OF TEACHING.

In organizing the Central School its founders took for their model the old Polytechnic School, (*Central School of Public Works*), with the modifications required by the object they had in view. For instance, they excluded from the curriculum every thing connected with mathematical theories of too high an order, experience having shown that such theories have but few practical applications.

At the Central School, as at the Polytechnic, the pupils are obliged, whatever may be the career they have chosen, to attend all the courses and to pass very strict examinations. The young men are thus prepared to follow almost any profession. It is, in fact, by no means unusual to see young engineers, on leaving this school, successfully pursue a different career from that originally chosen. At the Polytechnic School this generality of instruction extends to the theoretical studies only, since the pupils at the end of the three years' course are sent to one or other of the special schools to complete their education. At the Central School the instruction is purely theoretical in the first year only; in the second and third, theory and practice are blended.

The founders of the Central School justly remarked in their first prospectus:—  
“All the courses of the school really form but one and the same: industrial science is one; every manufacturer must know the whole under pain of being inferior to the rival who enters the lists better armed than himself. Arts apparently widely differing from each other make use of analogous operations, yet often employ very different methods. The general education of the Central School teaches how to transfer into each process of manufacture the improved methods used in others. It consequently tends to introduce into industrial establishments, and into the details of the processes or of the mechanisms, a degree of perfection which secures the harmonious working and general success of the whole.” This was a noble and prolific thought; it has produced abundant fruit.

The studies of the Central School and those of the Polytechnic School require very different qualifications. Though some of the pupils of the Central School have shrunk from the difficult tests required by the Polytechnic, we have good reason to believe that among the pupils admitted to the latter there are some who would not have succeeded at the former. The pupils who, after preparing for the Polytechnic School, enter the Central School, usually take the lead of their comrades in the first year, but often fall behind them in the second and third. The consequence is that the establishments which prepare pupils for the scientific and industrial schools have felt the necessity of adopting a special mode of preparation for the Central School.\* Again, the council of the

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\* In 1864, out of about 400 candidates who competed for admission to the Central School, only 50 had prepared for the Polytechnic School.



Central School, which at one time used to admit for the second year's studies candidates who were able to pass a satisfactory examination on the subjects taught in the first, now require that every pupil shall go through the complete course in the school. Experience has clearly shown that the instruction acquired elsewhere than at the school can scarcely be a suitable preparation for the courses of the higher divisions, which are based on what the pupils have been taught during the first year.

The studies of the Central School may be thus briefly recapitulated:—

In the first year, pupils follow the course of descriptive geometry with applications; analysis, comprising the elements of the differential and integral calculus; kinematics, general mechanics, general physics, general chemistry, construction of machines, and hygienics.

In the second and third year, courses of applied mechanics, construction and putting up of machines, analytical chemistry, industrial and agricultural chemistry, constructions, (civil buildings, public works, and railways,) applied physics and steam-engines, metallurgy, mineralogy, geology, and working of mines.

The course of construction of machines, which is very complete, as well as that of applied physics and steam-engines, and the course of applied chemistry, are peculiar to the Central School. The teaching of mechanics is also conducted on a new plan, in a spirit essentially practical.

The oral instruction of the Central School is judiciously completed by imposing on the pupils numerous studies of projects, by manipulations in the laboratory, by visiting workshops, by mineralogical and geological excursions, and especially by frequent compulsory examinations, not only at the end of each year's studies, but also during the courses and at their close. The pupils, in drawing out projects and in chemical manipulations, begin to apply what they learn in each course, and thus prepare for the more serious operations of practice.

The numerous examinations, one at least every week, have an excellent effect in keeping the pupils always up to their work. When a falling off appears in the marks obtained at the examinations, the director recommends the pupil to be more diligent, and, if necessary, summons him before the council of order, composed of the director, the sub-director, the director of studies, and a professor or a member of a school-council. The pupil is also cited before the council if he commits any breach of discipline, such as being noisy in the classrooms or amphitheatres, refusing to obey, &c., or if he be frequently absent without reasonable cause. If a pupil does not heed the friendly advice of the council of order, he is called before the school-council and more or less severely reprimanded. Any pupil found incapable of following the courses with profit is requested to leave the school, and if he refuses he is struck off the lists, after the minister's approbation has been secured. The pupil who persists in disorderly behavior is liable to expulsion.

For every pupil an accurate account of his examination marks and notes of conduct is kept in a ledger reserved for the purpose, and extracts therefrom are sent to parents when requested. These notes are useful not only as enabling the superiors of the school to form a correct judgment of each pupil's progress and conduct, but they also play a very important part when, on the pupil's leaving the school, after completing his studies, the council of professors has to decide on the terms of the certificate he deserves.

At first the council of the school, when definitively classing the pupils according to their merits, took into account only the marks obtained at the final competitive examination at the end of the third year, when each pupil had to present a project on a given subject. But experience soon showed that a pupil who answered correctly the questions put at the examination was not unfrequently a very indifferent pupil favored by a lucky chance. It was therefore decided that the average marks of the third year should be added to those of the competition in appreciating the merits of the candidate. As pupils were often found to be somewhat negligent in the second year, it was subsequently deemed advisable to carry this principle still farther and take into account the marks of the second year in awarding the diploma or certificate of capacity, and in assigning the pupil his place in the list published in the *Moniteur*. With all these precautions, it is scarcely possible that there should be any great mistake in appreciating the merits of the pupils.

This fact seems to have been well understood by manufacturers, for most of them require candidates to produce either a diploma or certificate, and as the latter is of less value than the former, we every year see old pupils who have obtained certificates only, present themselves again to compete for the diploma.

The number of diplomas and certificates has perceptibly increased during the last few years, although the examinations are more severe than formerly; this increase is owing to the greater strictness of the examinations for admission, which can be successfully passed only by pupils who possess considerable talent and have made good use of their previous opportunities. It is easier to get admitted to the Central School than to the Polytechnic, but far more difficult to obtain a diploma there than to leave the Polytechnic with a place under Government. At the Polytechnic School the number of pupils who fail at the examination on leaving seldom exceeds two or three per cent.

Prof. F. Jenkin, a fellow of the Royal Society, a member of the Institution of Civil Engineers, and professor of Civil Engineering in University College, and lecturer on the same subject in the University of Edinburgh, before the House of Commons Select Committee on Scientific Instruction in 1868, remarked in substance:

The *Ecole Centrale* is the great school for mechanical engineers, although other specialities are as well provided for. There is nothing whatever corresponding with it in England. Neither King's College nor University College is intended to answer the same purpose, and the teaching is on a much lower level. My own lectures for civil engineers are only preparatory for such a course as that of the French school. I heard a lesson in mathematics given in the second year, which required the student to have a very considerable amount of mathematical knowledge before he could at all follow it. In the first year they have the differential and integral calculus. The result of the good preparation, and of the whole course, is to turn out men who have received a very good scientific education, and who are very competent to take places immediately, especially as draftsmen. There is a peculiarity in the practical teaching, viz., the getting up the *projets*. There are eight every year, and a month is allowed for getting out the drawings, the estimates, and the specifications for each—as for instance one on shafting; one on girders; one on locomotives; one on boilers, &c. This kind and amount of practical work, done under the severe cross-examining and supervision of the professor, as to all the details, is of the highest value.



## PROGRAMME OF CENTRAL SCHOOL OF ARTS—1868.

The Central School of Arts and Manufactures, founded in 1829 by private enterprise, but adopted by the State in 1859, continues under the Ministry of Agriculture, Commerce, and Public Works. Its main object is to educate engineers and foremen for all branches of industry, and for public works, the direction of which does not necessarily belong to the Government engineers.

Diplomas of Engineer of Arts and Trades are delivered annually by the Minister to the pupils designated by the school-council as having passed through the entire competitive examination in a completely satisfactory manner.

Certificates of capacity are granted to those who, not having passed through all the subjects of the examination in a perfectly satisfactory manner, have nevertheless given proof of sufficient knowledge in the most important branches.

## CONDITIONS OF ADMISSION.

The school receives day-scholars only. Foreigners can be admitted, and on the same conditions as natives. The duration of the studies is three years.

The cost of instruction, comprising the expenses of the various manipulations, is 800 francs annually.

Independently of these 800 francs, the pupils must deposit in the school treasury, at the commencement of every year, a sum of 35 francs, as a guarantee for such objects belonging to the school as may be lost or spoilt by their fault. This deposit, which must at each term of payment (there are three in the year) be maintained at the total of 35 francs, is reimbursed to each pupil at the end of the year, or when he leaves the school.

Each pupil must, on entering the school, be provided with the objects and list of what will be delivered to him, and which a duly authorized purveyor will furnish, on demand, at a price fixed each year by the director.

Subsidies may be granted by the State to pupils who are at one and the same time recommended by the high position they take in the school, after the various examinations, and by want of means. These grants are made for one year only, but may be continued, and even augmented, in favor of pupils who render themselves worthy thereof by their conduct and by their progress in knowledge.

The State subsidies may be cumulated by allowances granted to the pupils by the departments and the communes.

The total of the subsidies are paid into the school treasury.

If the total of the grants obtained by a pupil exceeds the cost of instruction, one-twelfth of the surplus is paid to him, every month, for his board.

Candidates who desire to obtain a share of the State grants, must make a written declaration to that effect, to be sent in to the *prefecture* of the department. This declaration must be accompanied by a petition addressed to the Minister, and supported by a certificate of birth and a certificate of good conduct from the head of the establishment in which the candidate has completed his last year of studies, or, in default of this, by the mayor of his last place of residence.

Admission can only be obtained by means of competitive examination.

The examination is public, in so far as it is oral; it takes place in Paris every year, in two distinct sessions, between which the candidate may choose.

The tests consist in written compositions, and in oral examinations, bearing upon the following subjects:—1. French language. 2. Arithmetic. 3. Elementary geometry. 4. Algebra, as far as the general theory of equations, exclusively. 5. Rectilinear trigonometry. 6. Analytical geometry. 7. Descriptive geometry, as far as left surfaces, exclusively. 8. All those parts of physics which precede the theory of heat in the lycées. 9. In chemistry, the general principles and the metalloids. 10. Natural history. 11. Drawing, free-hand and linear, and washing in.

All the matters comprised in the detailed programme are equally obligatory. Candidates whose knowledge of any one of these subjects is considered insufficient, can not be admitted.

The written compositions may have reference to all the divisions of the pro-



gramme; correct and methodical writing, as well as a regular and very legible handwriting, are essential conditions. The candidate must, beside, execute, under *surveillance*, a diagram, (*épure*), in descriptive geometry, and an architectural design, including ornamental parts, which the candidate must draw on a reduced scale, after a model drawing. Some part of this drawing should be washed in in pale tints.

The oral examinations follow the written compositions.

All candidates must prove that they have filled their seventeenth year previously to the 1st of January of the year in which they present themselves for examination, and must produce certificates of vaccination and of good conduct.

The expenses connected with the examination are defrayed by the school, and candidates have nothing to pay.

After the conclusion of the *concours*, the list of the pupils to be admitted is definitively fixed by the Minister on the proposal of the School Council.

#### COURSE OF STUDIES.

*First Year.*—Analysis and general mechanics, 60 lessons. General physics, 60 lessons. Inorganic and organic chemistry, 60 lessons. Theoretical and applied cinematics, 24 lessons. Construction of machines, 20 lessons. Hygienics and applied natural history, 20 lessons. Mineralogy and geology, 30 lessons. Architecture, 10 lessons. Industrial drawing, 20 lessons.

*Second Year.*—Applied mechanics, 60 lessons. Strength of materials employed in machines and constructions, 24 lessons. Construction and mounting of machines, 60 lessons. Analytical and industrial chemistry, 40 lessons. Metallurgy, 20 lessons. Civil constructions, 60 lessons. Industrial physics, 45 lessons. Industrial and commercial legislation. Ceramics, 8 lessons. Dyeing, 12 lessons. Glass-making. Mining, 20 lessons.

*Third Year.*—Applied mechanics, 60 lessons. Construction and erection of machines, 55 lessons. Analytical chemistry, 20 lessons. Industrial and agricultural chemistry. General metallurgy and metallurgy of iron, 60 lessons. Mining, 20 lessons. Public works, 60 lessons. Steam-engines, 35 lessons. Railways, 40 lessons. Naval constructions, 25 lessons.

In addition, the following practical exercises and studies are required:—

*First Year.*—Various chemical manipulations. Exercises in general physics, stereotomy, and taking of plans. Architectural and topographical designs, and working drawings. Problems in the infinitesimal calculus, general mechanics, and general physics.

In the course of the year the pupils all undergo 27 examinations on the different branches of study, and a general one at the end of the year. During the vacation after the first year's studies, the pupils are expected to make plans of buildings and machines; also to write an essay on the resistance of materials.

*Second Year.*—A practical study of the flow of gases with the aid of an anemometer and a ventilator; each pupil to draw up a paper on the subject. Construction with bricks, according to given plans, of various chimneys, a baker's oven, a lime-kiln, a hot-air stove, &c. Each pupil to make a survey and draw a plan of a water-course, and to measure the volume of water in a stream; a paper to be sent in upon the details of these operations. Practical exercises in a factory on the construction of machines. Twenty-seven manipulations in analyzing and assaying. Drawings and projects of machines and buildings. Each pupil passes 21 examinations on the different subjects studied, besides the general examinations at the end of the year. During the vacation after the second year, the pupils are to visit manufactories, &c., and to hand to the director, on resuming their studies, a diary giving a summary account of the studies made and the factories visited; an album containing notes and sketches made on the spot; fair drawings of the most remarkable objects contained in the album; and a paper on questions of applied mechanics.

*Third Year.*—Projects, in two series; the first in the more important subjects of all the courses, and comprising four different studies, required from all the pupils of the division. The second belongs exclusively to specialties and consists of four projects on subjects connected with machines, buildings, metallurgy, and chemistry.



# ESTABLISHMENT OF ST. NICHOLAS,

PARIS.

REPORT OF E. DUCPETIAUX.

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IN 1827 Monseigneur de Bervanger, at that time directing a charitable association of mechanics under the protection of St. Joseph,\* (the first experiment in those adult classes which have since accomplished so much good,) conceived the idea of opening an asylum for orphan and poor children, for their training to the laborious occupations which must one day support them. He soon collected seven in the garrets of the Faubourg Saint Marceau; such was the modest beginning of an enterprise since so largely developed. By charitable aid it became possible after six months to hire a larger tenement; others were occupied in succession, the rent rising from twelve hundred francs to five thousand. At last, convinced that buildings of its own were necessary to the establishment of the institution upon a substantial footing, Mgr. de Bervanger decided to purchase two roomy houses, one at Paris, 112 Rue de Vaugirard, and the other at Issy, the ancient *château* of that name, now 36 Grande Rue, capable together of accommodating about a thousand children, all boarders.

The Paris house is the principal one, that at Issy being only a sort of auxiliary where the younger children are kept, in preparation for their removal to Paris.

The house in Paris has been portioned out upon a plan which seems to us to contain many defects, especially in regard to classification, and to ease of household services and supervision. The small court which gives entrance from the *Rue de Vaugirard* is lined on one side with cook-shops and refectories, and on the other by the laundry. In front is the building occupied by the management. Behind this building extends a large area divided into a garden for the use of convalescents, and a play-ground. A large building surrounds this area, and stretches on one side quite to the Rue de Vaugirard. The work-shops occupy the basement and first story of this building. Above are the dormitories. The chapel, infirmary and recitation rooms are in the wing that extends toward the street. The buildings have been erected with an economy which we fear has been secured at the expense of strength. Thus, although new, they present a general appearance of dilapidation, which, together with the lack of neatness, makes a sufficiently unfavorable first impression upon the visitor's mind.

Children are not received, except at from eight to twelve years of age. Those less than ten are sent by preference to Issy, where they receive special attention. They are required to bring a copy of their record of baptism, and a certificate of vaccination, unless they have had the small pox. Before final admission, they are

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\* This association, commenced in 1822, lasted until July 1830. It was composed of nearly seven thousand mechanics of various kinds, a thousand or twelve hundred heads of commercial houses or manufactories also belonging to it under the name of protectors. On Sundays and feast days the members met for divine service; recitations and games occupied the rest of the day. Mechanics holding a commendatory certificate from their cure, were lodged and boarded gratis until employment could be found for them, and schools were open every day at the hour for quitting work.

examined by one of the physicians of the institution. Orphans are required to present a copy of the record of the death of their parents.

The price of board, payable monthly in advance, is four dollars a month for orphans with no parent, and five dollars, for children not orphans. Four dollars are also paid to cover ordinary expenses at the entry of the new pupil. For this moderate sum, the establishment undertakes the general charge of providing for the maintenance, instruction and apprenticeship of the children.

The number of pupils had reached eight hundred in 1845, and nine hundred in 1846. It has varied little since the last date. This number consists of very heterogeneous elements, although some of them belong to poor and honest artisan families; and though there are even some scions of noble families, ruined by the revolutions, most of them have no family, no known parents, no name, and were running in utter abandonment to certain destruction. Charitable societies or generous patrons have rescued them and entrusted them to the care of Mgr. de Bervanger, who alone in the institution knows the secret of their birth. To preserve this secret, each child is designated only by a number by which he is known in the house.

The regulations are the same for all. The diet is adapted to the age, appearance and appetite of the pupils. It is at breakfast, soup and bread; at dinner, three times a week, soup, bread and meat, with a dish of legumes instead of the meat; on the other four days, at lunch, a piece of bread; and at supper, bread, legumes, or salad, or fruit. Sundays a little wine is allowed, and at the annual festivals, a dessert also. The food of the officers scarcely differs from that of the pupils except in quantity, and some slight additions of milk, wine, and fish. The whole is regulated by a bill of fare according to which, the distribution is made.

The establishment furnishes clothes and washing for the children, does their mending, and provides for each a mattress, bolster, two coverlids, two pair of sheets, four pair of stockings, four napkins, two pair of pantaloons for winter and two for summer, a waistcoat, a coat of cloth or knitwork for winter, five blouses, a cap, two pair of shoes, six handkerchiefs, two belts, suspenders, and combs; all marked with the number of the scholar. It also provides books, paper and pens for the classes. Children are received with whatever they have on, and at leaving, are permitted to wear away their every day suit.

Although the system of education in the establishment is a christian one, the director, out of regard for the character and prejudices of the mechanic population of Paris, has avoided giving it a clerical or monastic character. The teachers are laymen, and the name of "brothers" which they use to each other or receive from the pupils, is simply a token and bond of affection. The management of Saint Nicholas is entrusted, amongst the superior, a council of administration, and certain almoners and intendants. Under their orders the brethren are employed; the principal of them being the sacristan, the cashier, the proctor, the prefect of studies, the prefects of health, of music, and of the workshops. Mgr. de Bervanger has laid down the attributes and duties of all persons employed, in a sort of constitution containing excellent precepts, and which might be consulted to great advantage in the organization of similar establishments.

The household proper, cooking, expenditure, washing and ironing and the infirmary are in charge of a number of sisters of charity. The number of persons employed is seventy grown people, permanently; twenty-five masters or foremen



of exterior workshops; and thirty persons, hired by the day. Seven or eight of the children are also employed.

This large force permits the maintenance of an active and continual watch over the childrens' department; and any who are likely to corrupt their companions, are at once sent back to their parents or guardians. The brothers sleep among the children. One is watching in the dormitories, during the whole night, and the rooms are kept constantly lighted for fear of accidents. The children change about their sleeping places from time to time, and great reserve is practiced in regard to this arrangement, that there may be no way for the children to learn any thing evil. The older children get up at half-past five in summer and six in winter; the younger always at a quarter past seven. All go to bed at eight in winter, and nine in summer. The instruction includes reading, writing, arithmetic, and spelling; the elements of French grammar, geography and history, grammatical and logical analysis, book-keeping, linear drawing, practical geometry, singing, a thorough knowledge of instrumental music, gymnastics, swimming, the rudiments of physics, chemistry, practical natural history, land-measuring and gardening.

The instruction in physics, chemistry, natural history, geometry and instrumental music, is given only to the children in the first divisions; as also that in book-keeping, linear drawing, and singing. All the pupils are permitted to learn gymnastics and swimming, if their parents or guardians have consented. The instruction in surveying, and in some other of the above studies is given while horticulture is taught, at Issy.

The children do not remain in school more than three hours together, and are kept busy on one subject from half an hour to an hour and a half at the furthest. Those who do not work in the shops spend eight hours daily in studying and reciting, except the smaller ones, who rise later, and have but six hours and a half. A class consists of from fifty to seventy pupils at most. There is an examination several times a year, and a solemn distribution of prizes at its conclusion.

The business of the brothers is to render the studies attractive and varied, and to habituate the children to tell what they have learned or observed. They permit them to ask questions, and answer with good humor. Nothing is left to arbitrary decision; the smallest details are regulated according to rule; and the children know their rights and the penalties for non-fulfilment of duty.

The brothers extend their care not only to the instruction, but also to the general training of the children. They endeavor to imbue them with all such knowledge and habits as may insure their future prosperity by rendering them honest, industrious and skillful artizans, by making them enjoy their labor, by destroying notions consistent only with a high social position, and by fortifying them against the bad examples which they will probably meet in the world.

Musical instruction occupies a large place in the system of education. Music is reckoned not only a means of recreation and enjoyment, but as an art which may become a useful means of subsistence to the young graduates. A number of them have in fact obtained situations of more or less value, in regimental bands. The establishment owns five thousand dollars worth of musical instruments, which when not in use are arranged in glazed cases. Besides the military band, the musical director has organized a choir for the chapel. Every Sunday at four o'clock in the afternoon, the children chant a *Salve* with remarkable skill, upon which occasion part of the chapel is open to strangers.

In the principal area of the establishment are erected a gymnastic apparatus,

see-saws, and various other machines, for the amusement of the scholars. Swimming lessons are given at Issy, where there is a large basin; the pupils at the Paris house march out there from time to time, with their band at their head, to practice various exercises.

Various workshops have been established for pupils who are to serve their apprenticeship in the establishment; including, besides the bakery, the shoemaking shop, the tailor's shop, &c., which are kept up for the use of the institution; others in various occupations which are partly trades, and partly arts, and are especially followed in Paris. Such are the occupations of chaser in bronze, watchmaker, lacemaker, designer of patterns for woven fabrics, mathematical instrument maker, ornamental worker in gold and silver, engraver in jewels and metals, maker of bronze settings, worker in imitation jewelry, embosser, saddler, hardware man, maker of lacerated snuff-boxes, worker in steel ornaments, ironmonger, painter on porcelain, worker in ivory, machinist, and cutler. Unfortunately, the revolution of February, which threw the industrial interests of Paris into disorder, did not spare the workshops of Saint Nicholas; and many of them are discontinued, or unprosperous. Efforts are however making by the administration to repair these misfortunes and to maintain regular labor.

The pupils do not enter the workshops except upon the express application of their relatives or guardians, and only after their first communion. The manual labor occupies on an average eight and a half hours per day; and the apprentices attend school two hours daily, unless their parents or guardians prefer to have them spend that time in the workshops, in order to become sooner perfect in their occupation. The apprenticeship occupies from two to four years, according to the trade. When it is ended, the pupils are allowed, if they choose, to remain in the establishment, and whatever they earn over and above their expenses is deposited, if they wish, to their credit in a savings' bank. Parents are permitted to have their children educated for whatever business they choose, having reference to their inclinations, strength, and intelligence. At the time of our visit, the number of apprentices was about a hundred.

The workshops are an expense to the establishment; but as pecuniary gain is no part of the scheme, the same maintenance is given to the children in the shops as to the younger ones, although their support costs more. Those who labor need more food; and besides, a larger number of overseers is necessary, to keep up the prescribed amount of supervision. The profits from work done go to the foremen of the shops, which makes them interested in carrying forward the apprentices, and in conforming to the regulations of the establishment. They are likewise obliged to furnish the tools used by the apprentices. The masters are especially holden to conduct themselves toward the children like kind fathers; and not to keep them at work too long in any one part of their employment, but to instruct them in the whole of it. All this is stipulated in the engagements made between the parents and the masters, and with the approbation of the establishment, which, however, does not bind itself to continue to keep any of the parties, either masters or apprentices; in order that it may always be able to remove from the institution any individuals whose presence is esteemed harmful.

In the classes, workshops, &c., the children receive good marks for application and for progress. Thrice a year they receive books, images, &c., in exchange for these marks, at a certain rate. The record of these marks is posted in the parlor of the house every week; as are also the marks given for weekly composi-



tions, and the quarterly record, which last is sent to parents or guardians. Pupils whose names remain upon the good conduct list during the whole quarter, receive a reward at its termination. There is a formal distribution of prizes, annually, just before the short vacation.

For the encouragement of the children, the managers arrange for them from time to time special recreations, for which some little expense is incurred. During the summer there are long walks, on which the pupils carry their provisions in their knapsacks; in winter, there are exhibitions in natural philosophy, ventriloquism, &c. These amusements are much desired by the children, and stimulate them proportionately to good conduct and sustained application.

There is a sufficient play-hour between the periods of study and of labor. The hours of recreation on Sunday, are from eight to ten, forenoon, an hour at noon, and from two to four, afternoon. On week days, they are an hour each, at half past eight, noon, half past three, and in the summer at eight in the evening. These periods are of half an hour only for those employed in the workshops. Sunday afternoon at three, the pupils from the workshops perform pieces of military music to an audience of their relatives who have come to visit them. During play hours the pupils may practice gymnastic exercises. Thursday, weather permitting, the brothers walk out with the children not engaged in the workshops; those being taken out on Sundays during the summer.

Parents and guardians may see their children in private every day, but during play hours only, and when the children have not been shut up for punishment. There are three vacations a year; three days at new year's, three at Easter, and eight immediately after the annual distribution of prizes. Pupils are not allowed any vacation in September, unless at the request, or with the permission, of the person paying their board.

The house is governed in a manner altogether paternal. The masters are aware that harshness brutalizes, destroys every honorable sentiment, and inspires a distaste for study and labor. Even when punishment is necessary, the children are to be convinced if possible that severity is resorted to only for their good. Punishments can almost always be commuted for with good marks. Those guilty of grave misdemeanors are shut up during play hours, under charge of a brother; but these detentions are not to take place during all hours of recreations, as some fresh air and exercise is necessary for the health of the children. If there is no amendment, they are forbidden to take their usual walks. Very seldom, the allowance of food is curtailed. The idea of shame and of penalty is attached to many things quite indifferent in themselves. The general rule is to incline the children to good conduct by encouragement; and in punishment, regard is always had to their health. No prison is used, because the regulations permit no child to be alone without supervision, and moreover, because it is undesirable to accustom their minds to that form of punishment. Those whose thoughtlessness is likely to lead the others astray, are kept apart. A jury of the most steady children returns verdicts against violators of the rules, or such as have tempted their comrades to any considerable transgression. In such cases the punishment applied is a humiliation similar to that used in the regimental discipline, unless the parents prefer to withdraw the culprit. The masters are cautious to prevent the abuse of this authority, but the practice has succeeded well, and punishments under it have become rare. To maltreat the children is strictly forbidden, on the prin-



ciple that judicious and moderate means will prevail where an indiscreet severity could only irritate.

The regulations and discipline are alike in the two houses at Paris and Issy, except as required by the difference of age in the inmates. The latter also serves as a convalescent hospital for invalids from the former, where they can enjoy country living, and exercise in the open air. A horticultural school is likewise established there with a green house and an orangery.

The plans of the superior of Saint Nicholas include the founding of an analogous establishment for young girls. This would be close by that at Issy, but entirely separated from it. It would be of great advantage by saving part of the two thousand four hundred dollars a year now expended for sewing and washing. The kitchen garden ground there, brought entirely under cultivation, would furnish the necessary fruits and legumes for its consumption. This combination would be very similar to that adopted at Ruysselede.

It is difficult if not impossible for us to state a decision upon the merits of the enterprise of M. de Bervanger. At the time of our visit, the vacations were just ending, and the reassembling of the pupils occasioned, doubtless, more disorder than usual; various important repairs were in progress; most of the workshops were either unoccupied or going on only irregularly. Accustomed to the strict propriety of the Belgian establishments, we were probably more displeased than many other visitors would be, at the appearance of certain portions of the building, and at the careless manner in which that important matter seemed to be attended to. Nevertheless, the zeal and devotion of the director are certainly worthy of all praise. Confined to his own individual resources, and deprived of all official patronage, his perseverance has overcome impediments which would certainly have stopped any man not inspired by truly charitable purposes, and by confidence in the excellence of the principle upon which the establishment is founded. By the side of the numerous high schools and boarding schools intended for children of the rich and middling classes, he has undertaken to establish a modest boarding school for poor and morally neglected children. This end has been attained. The work is doubtless susceptible of numerous improvements, but even as it stands, it has solved an important problem, namely, that of reforming and maintaining at the lowest possible price, in the midst of a great city, a numerous class of poor, who, without such assistance, would inevitably have grown up to swell the ranks of the mass of vicious men who always gather in centers of population.

The cost of purchasing and furnishing the two houses of Paris and Issy, was nearly \$240,000. Of this sum there was unpaid, in 1849, about \$125,000. This debt, if funded, would represent a rent of about \$6,200; not at all too large for an establishment so useful and important.

In 1844, of an average number of seven hundred and fifty children, and a hundred and six persons employed, the total expense was \$39,843.52. Deducting receipts for sales from workshops and elsewhere, amounting in all to \$2,156.31, the annual expense remains at \$37,647. Each child, therefore, costs \$50.25; about fourteen cents a day; about one-third of what the pupils at Petit-Bourg cost.

For complete education and maintenance of one thousand pupils—the number which both houses can accommodate—the director estimates that he ought to receive \$60,000 a year, of which \$24,000 would be for food, gardening, and payment of certain female assistants, and \$12,000 for interest.



This is sixty dollars a year for each child, which is the fixed rate for those not orphans. The deficit occasioned by the reduced rate of \$48.00 at which orphans are received, would be made up by gifts, subscriptions, and returns from sales.

The following notice of this institution is given by Rev. George Foxcroft Haskins, in his *Travels in England, France, Italy, &c.*, 1854.

But of all the institutions which I visited in Paris, none interested me so much as that of St. Nicholas. The great aim of the institution is to provide for the wants of these boys, a large portion of whom were orphans; to inspire them with a love of virtue and of industry; and to fit them, by the practice of their religious duties, to become one day not only good christians, but also skillful workmen. It is an institution of charity, because the sum demanded for board and tuition, one dollar a week, is so small as to come within the means of the poorer classes, and of those benevolent individuals and societies who have at heart the reformation and instruction of the destitute and abandoned. How many of these boys, think you, are sheltered, fed, and instructed in this home for the homeless and deserted? A hundred or two? More than that. Three hundred, perhaps? More than that. Five hundred? Yet more. There are at the present time more than *twelve hundred* boys in this mammoth refuge! They are divided into two departments, a senior and a junior, according to age. I visited both departments. All are governed by the same rule, and all are under the fatherly direction of Mgr. Bervanger. The two establishments are about half a mile apart.

This institution is governed and disciplined by a congregation or brotherhood, composed of secular priests and laymen, who devote themselves to this work, with a single eye to the glory of God and the welfare of youth, demanding nothing for their labors but a bare support, looking forward for compensation to the treasury of God.

The first and great aim of the directors and teachers is, to infuse into the boys a love of virtue and religion; the second, to impart elementary and scientific instruction; the third, to accustom them to habits of industry, and teach them a profitable trade.

The spiritual direction and religious instruction of the children is confided to the reverend fathers of the order of St. Dominic, who give four pious instructions every week. Catechism is taught every day. The scholars are divided into twenty classes, according to their age and degree of intelligence. They are not allowed to make their first communion till they have attained the age of eleven or twelve years. The singing and music at mass and vespers is performed by the pupils, under the direction of their musical teachers. I think I shall never forget the pleasure and edification with which I assisted at the Divine offices at St. Nicholas, on the Sunday which I passed in the institution. It was in the chapel of the senior department. There were about six hundred and fifty boys present. All behaved with the most perfect decorum. In discipline nothing was wanting. All appeared to unite in the singing, but without a discordant note. The time was so well observed, that every word was articulated and heard as if pronounced by a single voice.

In the schools are taught reading, writing, arithmetic, orthography, grammar, geography, history, book-keeping, drawing, geometry, vocal and instrumental music, chemistry, and natural history. Out of the schools are taught surveying, agriculture, horticulture, gymnastics, swimming, and various handicrafts.

There are about twenty workshops attached to the institution and within its precincts. Before the children commence their apprenticeship, their tastes, their preferences, their physical strength, and their intelligence are consulted. I observed, in passing through the shops, a large number of boys employed busily in carving, cabinet-making, turning, musical instrument making, jewelry, brass finishing, tailoring, shoemaking, &c., &c. The boys are apprenticed for a certain number of years to master workmen, who pay to the institution, for the board of their apprentices, the same as is demanded for the other inmates.



The following notice of the Ecole St. Nicholas is taken from a "letter addressed by B. Samuelson, Esq., M. P., to the Vice-President of the Committee of Council on Education concerning Technical Education in various countries abroad," and printed by order of the House of Commons, November 26, 1867:

One of the most interesting establishments in France is the Ecole St. Nicholas, which educates and teaches a trade to eighteen hundred pupils. It was founded by Monsignor de Berringer, and is now conducted by the Christian Brothers, under the superintendance of a board of managers, of which the Archbishop of Paris is the president.

It consists of two schools, one in the Rue de Vaugirard, near the Luxembourg, and the other at Issy, in the suburbs of Paris. Issy, which receives children at the age of seven years, is a preparatory school for the one in the Rue de Vaugirard, to which they are transferred if sufficiently advanced at the age of ten. When they have completed their school education, they may, if they desire it, be placed as apprentices in the workshops forming part of the school buildings. The apprenticeship lasts four years, and the boys are taught by masters who follow their respective trades for profit. All without exception are boarders, and pay fourteen pounds ten shillings per annum for their board, education and clothing, but in the fourth year of apprenticeship this payment is defrayed by the master.

The entire income from school-fees and subscriptions is about twenty-five thousand pounds, and the subscriptions do not probably amount to more than one-tenth of this sum. There were seven hundred boys in the school of the Rue Vaugirard, and one hundred and forty apprentices in the workshops when I visited them.

The staff of teachers, all of whom are "frères," is ample. The boys are well clothed, and although their food would probably be considered insufficient for growing English lads, they looked healthy. I inquired whether they had lost many pupils during the cholera epidemic of 1865, as I knew it had been severe in that part of Paris, and was told they had only one, and that one an imported case.

The dormitories are scrupulously clean, and both these and the class-rooms are airy and well lighted. The instruction, though nominally primary, is carried beyond what have hitherto formed practically in England and France the limits of elementary education.

I saw about sixty boys of from twelve to fourteen, in the drawing-classes. The work of even the younger boys was good, and the older ones drew the details of machinery from models and dimensions correctly and neatly.

Some of the architectural drawings also were good; one or two would not have disgraced an architect's office. Reading was made the occasion for exercises in parsing, the derivation of the words, both from the roots and from the Latin, being given by the boys.

In arithmetic, vulgar fractions were well worked, and the theory appeared to be fairly understood. Comparing this school with some of the best elementary schools that I saw in Germany and Switzerland, I found the drawing here much better, and the results of the general instruction very fair, though the methods were inferior, and the art of the teacher was evidently not understood as it is in those countries. The boys in the workshops were being taught the stock trades of Paris, the manufacture of bronzed articles, of optical and musical instruments, carving in wood, gilding, saddlery, &c., and some two or three youths of seventeen or eighteen were modeling in clay; one showed considerable talent, and great expectations were entertained of him as a sculptor. Half-a-dozen boys were drawing shawl-patterns for one of the great Paris designers. The work was real paying work such as I had seen in no other apprenticeship school, except perhaps at Crefeld.

The apprentices have special classes in mechanical, ornamental and figure drawing, and in vocal music, between the hours of divine service on Sundays.



## DEPARTMENTAL AND COMMUNAL SPECIAL SCHOOLS.

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Out of the numerous technical schools in France which private enterprise or the competitions of international trade have created in the great centers of industry, we select a few only for detailed description.

### TECHNICAL SCHOOL (LA MARTINIÈRE) AT LYONS.

THE TECHNICAL SCHOOL at Lyons, known as *La Martinière*, was founded by the bequest of Major General Claude Martin, who left Lyons a poor boy, and having fought the English under Tippoo Sahib, entered the service of the East India Company, and died at Lucknow in 1800—leaving one-half of his estate to found an industrial school in India, and the other half a similar school in his native town.

Its endowment pays the annual sum of 100,000 francs. Gratuitous instruction is given to about five hundred pupils, in addition to which there is an evening school, which is attended by two or three hundred adults. It is well provided with buildings and apparatus, which cost more than a million francs.

Its purpose, broadly sketched, is to give to the children of the poor, just before they commence their apprenticeship, a course of scientific instruction, having constant reference to industrial needs. Pupils are admitted between the ages of twelve and fourteen and a half; older pupils only exceptionally; their parents must be residents of Lyons or in the Department of the Rhone. Besides the conditions of being healthy, of having been vaccinated, or having had the small-pox, they must pass a preliminary examination, which is held between October 15th and 30th, in reading, writing, and the first four rules of arithmetic.

### GOVERNMENT OF THE SCHOOL.

The direction of the school is in the hands of an administrative commission, consisting of the mayor of the city, the executors of the founder, and seven others chosen by the municipal council and approved by the Minister of the Department. It regulates all the internal and external affairs of the school; authorizes all expenditures, fixes the salaries, arranges the curriculum, inspects the classes, elects the professors and dismisses them at pleasure. All orders are given in its name. It receives from the director a quarterly report upon the condition of the school.

The director is charged with the execution of the orders of the commission, and a general supervision. He makes a quarterly report to the commission, and another to the parents or guardians of the pupils.

The registrar is the financial agent, and is, if possible, chosen from among the family of the founder. He makes no payments, except upon order from the commission. He reports to the director.

The censor is an officer having inspection of the studies and the expense of

the school, and fills the place of the director in case of absence. He makes a quarterly report directly to the commission. Under his care are the buildings and apparatus. He must give four hours a day to his office.

An inspector and two sub-inspectors have immediate care of the furniture and apparatus, and watch over the discipline of the school. They are under the orders of the censor, but they report to him or to the director, according to the nature of the matter in hand.

The budget of the institution is annually submitted to the prefect of the Rhone and the municipal council of Lyons.

#### INSTRUCTORS.

The corps of instructors includes the following officers:—Professors. Assistant professors. Class teachers, (*chargés de cours.*) Tutors or assistants, (*maîtres.*) Repeaters, (*répétiteurs.*) Overseers of the workshop. Assistant repeaters. These titles are conferred by the administrative commission, and their application is rigidly observed.

The duties of professors, assistant professors, teachers and masters are distinctly defined. They have charge of the courses, and make certain reports to the director, concerning the conduct and proficiency of their pupils, and to him they must give previous notice of intended absence. Failure to give such notice, and absence not approved by the administrative commission, are punished by the retention of a part of their salary. They make also an annual report to the commission, concerning the proficiency of their scholars.

The repeaters assist in the recitations, taking upon themselves the more mechanical and laborious part of the business of it, and give additional instruction, as the instructors with whom they are connected may require. Their assistants are chosen from among the prize graduates of the school.

It is desired to connect, as far as possible, the same instruction with the same pupils throughout the two years.

The students of mathematics are divided into six sections, each of which has a professor, assistant professor, or teacher.

There is a professor or assistant professor of chemistry for each year of the course. There is also a repeater for this branch, who has the oversight of the manipulations, and is assisted by a *préparateur* and two assistant repeaters.

The professors of chemistry are responsible for the apparatus and chemicals, although the *préparateur* has the immediate charge of them.

#### DISCIPLINE OF PUPILS.

The pupils are required to be regularly present, to be punctual, and to preserve perfect silence during school hours. The following punishments may be inflicted:—

Increase of work; the lowest place in the class; the ordinary retention; retention upon bread and water; expulsion.

Expulsion is inflicted by the administrative commission alone, and then only after eight days' notice to the family of the offender.

#### COURSE OF INSTRUCTION.

The course of study extends over two years, and includes the following branches:—



1. Mathematics, embracing arithmetic, algebra, geometry, trigonometry, descriptive geometry, physics and mechanics. 2. Drawing applied to the industrial arts. 3. Morals. 4. Grammar and writing. 5. Manual labor. 6. Chemistry. 7. Fabrication of goods. 8. Practical carving.

The branches 1, 2, 3, 4, 5, are studied by all; 6, 7, 8 are special courses, pursued by only a part of the pupils. The seventh course (fabrication of goods) includes a weaving-school, and an advanced chemical class.

During the course of chemistry, the principles of optics involved in the art of dyeing are taught. To answer practical demands, there are workshops connected with the school, where are practiced turning, carpentry, working in metals, working with the point, (*la mise au point*,) carving soft stone and wood, and modeling in plaster.

This course is extensive, but it is carried through successfully by the economy of time secured by the method hereafter detailed.

The academical year commences November 3d, and closes the day after the distribution of prizes. There is a vacation of eleven days at Easter. During these vacations instruction is given to such as desire it, to fit them for entering or pursuing the studies of the school.

The sessions in term-time begin at fifteen minutes to six in the morning, and last until seven o'clock in the afternoon, the weariness of such a long session being relieved by practice in the workshop.

The hours which in other schools are commonly devoted to recreation, and Thursdays, (generally kept as holidays,) are dedicated to manipulations in the workshops.

We present a table of recitations:—

*Morning*.—Chemistry, 6.45 to 8.15.

Drawing, 8.30 to 10.15.

Mathematics, 10.30 to 12.05.

*Afternoon*.—Fabrication of goods, 2.30 to 4.

Morals, 3 to 4.

Writing, 3 to 4.

Grammar, 3 to 4.

Mathematics, 4.15 to 5.30.

Repetitions on theory of manufactures, 5.30 to 7.

Practical carving, modeling, and molding, 5.30 to 7.

In the workshops, 1st division, 12.5 to 1.10.

2d " 1.10 to 2.05.

3d " 2.05 to 3.

Chemical manipulations, Thursdays, 6.45 to 10.

Work in the workshops, " 10 to 1.45.

All apparatus required for the studies and recitations is furnished by the instructors to certain pupils called heads of divisions, (*chefs de brigade*,) and is, after it has been used, collected by them, and locked away.

Pupils not able to keep up with the class (*retardataires*) are formed into a separate class by themselves with a more confined range of studies.

It is intended that the pupils shall prepare a part of their lessons at home.

#### COURSE FOR ADULTS.

The course for adults is held during the evening, after the hours of work, from November 10th until March 20th. All adults are admitted, and the attendance

is very satisfactory. Provision is made in them for those whose education has been neglected, and that past graduates of the school may increase their stock of knowledge without neglecting their daily occupations. The course is practical, and has reference to the trades practiced by the auditors.

#### METHOD OF TEACHING.

The method of teaching adopted at La Martinière was devised by M. Tabareau, a workman of Lyons. Its fundamental principle is concerted action carried to its farthest extent, in listening, in questions, in answers, and in work, while above all the attention is incessantly stimulated. It is so carried out that, since all is done collectively and individually, even to the oral questions and the written answers, the whole lesson is directed at once to each and all. Inattention is rendered almost impossible by the liability of each one to be suddenly called upon.

The recitations are conducted upon a plan which, in exactness and rapidity, resembles that of a military drill. Let us detail this plan.

The recitation room is furnished with tables on each side of a central aisle. Each table will accommodate seven pupils, and the places at each are numbered from the aisle toward the wall, from one to seven. Now, considering the pupils to form ranges parallel to the aisle, the row nearest the aisle is called range one, the next range two, the next range three. Again, the fourth range from the aisle is called range one, the fifth from the aisle range two, and the sixth range three. The seventh place from the aisle, or last range, is again called range one. All the pupils in the places called range one are considered to belong to the first series; all in the places called range two to the second series, and in range three to the third series. The object of this arrangement is that no two pupils of the same series shall sit beside each other and copy from each other's slates, for a written question or an example is given to a whole series at once.

Nos. of the tables.	Series.							Nos. of the tables.								
	1	3	2	1	3	2	1									
	Pupils.															
1	7	6	5	4	3	2	1	Free passage way.	1	2	3	4	5	6	7	2
3	7	6	5	4	3	2	1		1	2	3	4	5	6	7	4
5	7	6	5	4	3	2	1		1	2	3	4	5	6	7	6
7	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8
9	7	6	5	4	3	2	1		1	2	3	4	5	6	7	10
11	7	6	5	4	3	2	1		1	2	3	4	5	6	7	12
13	7	6	5	4	3	2	1		1	2	3	4	5	6	7	14



Each place at the tables is provided with a large slate for performing operations, and a little hook which can be seen from the professor's desk.

Let us now suppose the class assembled. At each table is a pupil called the head of the division, (*chef de brigade*.) The professor gives the word of command, "Slates!" upon which the heads of the divisions come forward to his desk and take each a box containing seven small slates, and returning hang one upon each hook before a scholar. These boxes, be it remarked, lie, when on the teacher's desk, in pigeon holes, each of which corresponds to a particular table. All being ready, the professor says, "First series!" and puts a question, and immediately "Second series—third series!" giving a question to each. The question is generally the same, but modified somewhat in its terms, so that the answer in each series shall be different, the professor possessing a table of questions prepared for this purpose. The whole three series now prepare the answer, or if it be the problem, the solution. When the answer or solution is ready, it is written by each upon his small slate, which is then hung upon the hook, and when all the hooks are filled, the order is given, the heads of the divisions collect the slates of the whole class, replace them in the boxes, and put the boxes in their places before the professors. They carry back another set of small slates, and the process is repeated.

While the second set of questions is being answered, the professor has time to examine the slates first brought back, the process being the more rapid, since all the slates from the same series should present the same response, and the professor is provided with a complete set of answers.

After the second set of small slates is returned, questions are put upon the first set. Then another set is distributed, and the same process is again repeated.

For oral answers, the pupils are numbered at each table, and, when a question is put, the professor says, "third, fifth," &c., meaning the fifth at the third table, &c., rapidly calling on one after another to complete, explain, or correct. So the pupils' attention is kept constantly on the stretch, and great attention is paid that no time shall be lost. All is executed with the precision of a military drill. For instance, if an operation is to be performed on slates, the cry, "slates!" (like "attention!") brings the right hand of every pupil to the handle of his slate, then at two quick raps, which follow, the slate is placed in position for work.

The system just detailed is applied, as far as circumstances allow, to all the branches taught.

#### INSTRUCTION IN DRAWING.

The method adopted at La Martinière to teach drawing is quite peculiar. It is considered by the devisers that the usual plan of copying from prints delays rather than advances the pupil, inasmuch as he is never required to exercise his mind in the study of perspective. Therefore the scholar begins immediately to draw from a model. He is taught to consider his model as an assemblage of geometrical figures, cones, cylinders, etc., and starting from this he is soon able to draw a machine at least, since in this the whole arrangement is mathematical.

For four or five months he draws upon a slate, then upon paper; and within the same year is exercised in making plans, sections, and elevations of machinery. During the first year he uses no rule, square or compass, having only the eye for guide. During the second year he sketches and draws from mem-

ory, and designs machinery, availing himself of the various instruments used by draughtsmen. The course is finished by washing in a perspective drawing of some machine, and by a composition upon some given subject of perspective.

The room in which the exercise is carried on presents a peculiar aspect. The students are gathered in groups of twenty-five about models or machines, raised on a pedestal, each student sitting astride on a peculiar seat, with a board before him, which is provided with various appurtenances serving to elevate it, depress it, or to otherwise change its position.

The method has proved very successful, and the system of drawing from the model at first has not disappointed its devisers.

#### INSTRUCTION IN MORALS.

As only day-scholars are received at this school, the opportunities for moral instruction are somewhat limited. But considering that in the poor families to which the pupils generally belong, there is little time for that home influence which is the chief reliance in the moral education of youth, and that it is the aim of the school not merely to make good workmen but good citizens for the State, it was determined to establish such a course.

It was thought that an ecclesiastic, kind, intelligent, and well-informed, and moreover one possessing a fondness for children, would be the best person to fulfil all the requirements of the position.

An hour a day is assigned to morals, and the course is conducted in a familiar manner. The subjects are: our duties towards God, society, and self; morality, good, evil, reason, society, and the conduct of our internal self, a course more complete probably than is given in any other school not distinctively religious.

#### THE APPARATUS.

The school is well provided with apparatus, and possesses a collection of machines and models. For the chemical course, there is for every trio of scholars a set of reagents, a spirit-lamp, and a gas-trough.

The collection of apparatus illustrating geometry and mechanics is very complete. To the students of geometry are furnished little boxes of wood serving as horizontal planes of projection, on which are constructed, by needles, all the geometrical figures which can be represented by straight lines. There is a large collection of models of machinery, capable of performing their proper movements.

For the drawing classes are provided models and a peculiar apparatus illustrating perspective, consisting of geometrical figures constructed of iron wire, representing the various changes undergone by them in accordance with that law of optics.

This list is completed by a collection of drawings upon pasteboard, on a large scale, of the various objects required to illustrate the courses.

The museum containing this collection of apparatus is open to the general public twice a week, and members of the corps of instructors are present to give explanations.

#### PRIZES AND STIPENDS.

There is an annual distribution of prizes in each department of the school, given after an examination conducted by juries consisting of eminent gentlemen



not connected with the school, who are selected by the administrative commission. The prizes consist of medals bearing the effigy of the founder, of books, and tools. The medals for the pupils of the second year are of silver; for those of the second year, of bronze. Besides, bronze medals are given to all pupils of the second year who have received honorable mention. In awarding the prizes the rank obtained by the pupil during the year counts as a third.

Diplomas are issued, and good places are found for those pupils who have especially distinguished themselves.

As assistance are classed certain moneys given to the poor families of worthy pupils, these sums being large enough to be of material help. In this last form of award, attention has been paid to the moral effect upon the pupil of becoming so early a benefactor to his family.

#### SCIENTIFIC SPIRIT OF THE SCHOOL.

We will conclude this short sketch with an abstract of the general instructions given to the professors.

They are to vary the subject as much as is possible, both to show the connection that exists between the sciences, and to give rest to the mind by the change from one subject to another. All the faculties ought to be harmoniously cultivated. All is connection and ramification in these studies, and it is from comparing them that we derive results useful to humanity. Useless details, not leading to some essential or practical result, should be withheld. Abstract ideas should be, so far as possible, replaced by the concrete. Abstract ideas should be presented only so far as is necessary to perfect the demonstration of the logical connection of the argument.

So far as possible, appeal is to be made to the senses, for what we have seen with the bodily eye remains by us the longest of all. Show as soon as possible the practical application of a truth. It is by this last plan that we refresh the mind of the pupil, and that the students at this school are enabled to bear so long a session as ten hours without fatigue.

Teach that only which the intelligent workman is not likely to forget. It is a mistake to load these young minds with too much purely scientific detail, which is sure to be sooner or later forgotten. It is not impossible to impress the highest truths of science upon minds not familiarized with her. It is here that the toil of the professor must supplement what is lacking in the pupil. There is no food which is not suitable for the mind, if both mind and mental food are fitly prepared for each other. It is the difficulty of this double preparation that is to be overcome by talent and method.

Such is the scheme of La Martinière. Whatever be the results as to much of the scientific matter taught there, whether the pupil remember or forget it, it is certain that he will carry away habits of order, of method, and of study, a taste for work, a correctness of reasoning, much technical knowledge, and a sufficient initiation into manual labor, all which will profit him much in whatever he may do.

Mr. Samuelson, in his *Letter on Technical Education Abroad*, while expressing doubts of the great superiority of the *Methode Tabareau*, remarks: "This school imparts to boys twelve to thirteen years of age, in the course of two years, a wide range of scientific knowledge. The arrangements which I saw for teaching drawing from models, the laboratories, and the models in wood of machinery produced by the pupils in the workshops, were really admirable."

Since the foregoing account of the *La Martinière* School was drawn up from a pamphlet history of the same, we have read the evidence of M. Girardin, to the Commission on Technical Instruction, which is very favorable in the estimate of the methods and results of this school.

The majority of the pupils of *La Martinière* succeed in the careers in life which they select. There are in the town of Lyons a large number of skilled artisans who have sat on the benches of the school; the principal dyers are old pupils of the school, and to them is due the increased prosperity of the trade of the town by the remarkable discovery of the new and fashionable colors. The Polytechnic School has also received many of the pupils, and it is to their first success in *La Martinière* that they owe the brilliant position they have obtained, the just recompense of their assiduity.

The method of teaching descriptive geometry is thus described:—"Each pupil is furnished with a small tin box about eight inches long, four inches broad, and three-fourths of an inch deep. This is filled with yellow wax, so prepared as not to turn too hard. This represents to the pupil the horizontal plane of projection. The edge opposite to him is the ground line, and he can imagine to himself the plane of elevation passing through this ground line. Small strips of iron wire represent lines in space, the projections on the horizontal plane by laying them on the box, and those on the plane of elevation by fixing them on the edge which represents the ground line. The movement of these strips on the wax is effected by direction of the teacher, and the pupil is enabled easily to understand a diagram in descriptive geometry."

M. Girardin is director of the Central School at Lyons, which was established by an association, to be a complement to *La Martinière*—but for paying scholars in reference to the industries of Lyons. Drawing, from models and in projections; chemistry, with the greatest facilities of manipulations; mechanics, from models and parts of machines constructed by the pupils in the workshops; visits once a week to certain manufactories, from which figured sketches must be brought back to the school—are among the technical subjects and methods of this school. There are twelve professors, who are paid according to the hours devoted.



## SCHOOLS FOR WATCHMAKING.

A few years ago the watch and clock trade of France, which had been very flourishing, was greatly depressed by the superior article in taste and nicety of mechanism produced in Switzerland. To enable the workmen in the large factories, and the fabricators of detached pieces working in their own houses all through certain districts of France, to perfect their taste and skill, individuals, municipal authorities and the State encouraged in the primary schools instruction in drawing; opened cabinets of finished watches, movements, and detached pieces, for public inspection and private examination and study; offered prizes for the most finished as well as the cheapest specimens of workmanship; and instituted special schools for practical instruction in all the details of design and construction in this domain of art. The school at Morteau, in the department of Doubs, established in 1836, and another at Besançon, founded a few years later, were both aided by the departmental council, and the latter, by an annual grant of 16,000 francs. In consequence of these encouragements, the Besançon trade in the article of watches, gold and silver, has rapidly increased. In 1845, the total make was under 45,000, and in 1865 it was over 300,000—an increase due to the superior article brought into the markets of Paris.

## SCHOOL AT BESANCON.

The school at Besançon is one of the best of its kind in Europe. The instruction is both theoretical and practical—general and technical. The full course extends through three years. The candidate must be fourteen years old, and have had a good primary school education, and must pass an examination as to his general intelligence and aptitudes.

The general course embraces the French language, ornamental penmanship and drawing, arithmetic, algebra, geometry, and physics. The special and technical instruction covers all the requirements of manufacturers, finishers, and repairers. The practice is had in workshops, where the successive steps, of rough-casting pinions, making dials, and finishing various kinds of escapements, jewelery, and all accessory and finishing operations of putting together, casing, and regulating, are systematically taken.

Through this and other schools, a class of accomplished and skilled manufacturers and foremen have been educated, and a large number of intelligent and trained workmen have been scattered all through the department of Doubs, which enables its watch manufacturers to compete for a large share of the trade of the world.

## SCHOOL AT CLUSES.

In 1863, another school was established at Cluses, in the arrondissement of Bonneville, on the road from Geneva to Chamounix, towards which both the department of Savoy and the government gives pecuniary aid and supervision.

The object of the school is:—

- 1st. To train workmen for the manufacture of the different parts of watches.
- 2d. To procure the necessary instruction for those who are destined to be repairers, or makers of watches.

The school is administered by a director, with the concurrence of a council of administration. The director is nominated by the Minister of Agriculture, &c., and chosen from among persons well acquainted with the various branches of the art of watchmaking. His salary is fixed by the Minister.

The council of administration consists of the prefect, who presides; the



*sous-prefet*, who acts as vice-president; the director of the school; a member of the council-general of the department, the mayor of Cluses, and two of the principal watchmakers of the *arrondissement*.

The council receives once a year from the director of the school a report of the management, and gives its opinion as to this management; it determines, on the proposal of the director, the division, the hours, and the programmes of the lessons and exercises; it regulates all matters concerning discipline, and improvements to be introduced; and takes particular care that the instruction retain its practical character.

The instruction given in the school is gratuitous, and is both theoretical and practical.

The practical instruction comprises all the methods and operations suited to give to the pupils the manual dexterity necessary for one, or for several of the special parts of watchmaking.

The theoretical instruction comprises the elements of arithmetic, of geometry, and of mechanics. The pupils are besides practiced in making drawings of the various detached parts of a watch, and of the tools used in watchmaking.

The normal duration of the instruction is two years, and in no case can a pupil be allowed to remain more than three years in the school.

The staff of teachers consists of a master, intrusted with the theoretical instruction, and of heads of workshops, (*chefs d'atelier*.)

These teachers are all appointed by the prefect, but proposed by the director. Their salaries are fixed by the Minister, who also regulates the number of pupils to be admitted each year.

Candidates must be twelve years of age, and must produce:—

1. A testimonial of good conduct.
2. Must prove by examination that they have a knowledge of reading, writing, spelling, and the first four rules of arithmetic.
3. Must produce a certificate of vaccination.

They must, on entering the school, be provided with a certain number of tools, and must deposit a sum of twenty-five francs as a guarantee for any losses or deteriorations caused by their fault.

The pupils are distributed among the different workshops in the school, according to the judgment of the director. The proceeds of the work done in the workshops belong to the State.

The pupils are all day-scholars, and are placed by their parents in families domiciled in the commune of Cluses, and approved by the administration of the school.

The administration may, however, at the request of the parents, or for motives of its own, undertake to place the children. In these cases the parents must pay in advance every three months a sum of which the maximum must not exceed six hundred francs a year.

A certain number of places in the school are reserved temporarily for journeymen watchmakers who wish to perfect themselves in the fabrication of one part or of several parts of the watch works.

Grants (within the limits prescribed annually in the budget) may be made to pupils whose families are in straitened circumstances, and who have merited such aid by their industry and their good conduct. These grants shall be applied to the expenses of their board and lodging, and similar assistance may be afforded to the journeymen admitted temporarily into the school.

The pupils are subject to the supervision of the administrative authorities of the school, not only within its walls, but also when out of doors, or with the families with whom they live.

General examinations take place at the end of each year, in the presence of the director and of several members of the administration. At the conclusion of the examination, places according to merit and conduct are assigned to the pupils.

Certificates of study are given to pupils of the second year who are judged worthy of receiving them. These certificates indicate the degree of ability attained by the pupil as a watchmaker, with mention of the special part of the watch to which he has particularly devoted himself during his stay in the school.



## LACE AND RIBBON-FABRIC SCHOOLS.

To extend and perfect the elegant and difficult handicraft fabric of lace-work, a school of design, as well as a practical school for acquiring taste and dexterity in all the manipulations of twisting the thread, pricking the patterns, and working from the designs, exists at Dieppe. Numerous schools exist in different towns of France, (St. Etienne, Lyons, &c.,) where the trade in ribbons is largely carried on, for training not only designers of patterns, but artistic workmen in the chemistry of colors and all the details of weaving this fabric.

## WEAVING SCHOOL AT MULHOUSE.

The weaving school at Mulhouse was established in June, 1861, when the treaty of commerce with England was concluded which inaugurated a new tariff legislation and a closer competition between French and foreign industry. Under the lead of the Chamber of Commerce, whose members were impressed with the great services which such a school would render to young men, who could study the general theory of weaving and its various applications, the Industrial Society and other citizens of Mulhouse subscribed the sum of 40,000 francs to inaugurate the enterprise in a hired hall, and continue the school for at least three years. After that period of successful operation, the school was incorporated and became proprietor of a large building constructed especially for its use, and provided with all needful material, fliers, warping-mills, dressing machinery, and power-looms with one to six shuttles, and a steam-engine.

The school has two divisions—a theoretical and practical. The pupils of the first division decompose all the various kinds of tissues, whatever the design, and arrange them anew upon the cards. They are also taught free-hand drawing and design, building and machine drawing, commercial arithmetic and book-keeping. The second division are trained in all the manual labor of construction, repairing, adjusting, and keeping in order the various machines; the manner of handling the threads, setting in motion, and all the details of preparation and operating, under the direction and supervision of master-workmen. After a satisfactory examination, and trial-lessons, before experts, a certificate of capacity and skill for positions of directors, masters and weavers is given, which is a sure passport to employment at home and abroad.

## COTTON-SPINNING SCHOOL.

The spinning-school at Mulhouse was established in 1864, under the auspices of the Industrial Society. A capital of some 30,000 francs was realized by subscription, payable in three annual instalments, which maintained the school for three years, when it became self-supporting. It aims to train not only directors but master-workmen, who in addition to technical knowledge, may have correct ideas of industrial economy. The plan embraces a building composed of a hall for an industrial museum of designs and models of all machines used in spinning, and specimens of material; three rooms fitted up with from four to five thousand spindles each, for fine, ordinary, and rough work; a separate hall in which to set up new machines sent by constructors for trial, and to give to all its pupils instruction in drawing and design, as well as in the practical and theoretical working of the cotton mills, including a thorough knowledge of cotton culture, the conditions which determine the price of this staple, and a system of industrial book-keeping.



## INDUSTRIAL AND EDUCATIONAL SYSTEM OF THE CREUZOT ESTABLISHMENT.

One of the most remarkable features of the Paris Industrial Exhibition of 1867 was the display of the products of the vast mechanical workshops of Messrs. Schneider & Co., at Creuzot, situated in the Blanzey coal basin, about thirty miles west of Chalons-sur-Saone. The existence of this coal field, and of a deposit of oölitic ironstone extending over a vast district, led to the original establishment of Creuzot. The works were founded in 1781, and dragged on a precarious existence until they were purchased by Henry Schneider in 1836, after having been abandoned for several years. When they passed into his hands, 60,000 tons of coal were raised and 4,000 tons of iron produced annually. The wonderful change which has been wrought in this district, not only in the productive capacity of the mines, but in the intellectual, moral, and economical character of the population, is thus described by B. Samuelson, Esq., M. P., in his "*Letter on Technical Education*," addressed to the Commissioners on the subject, and printed by order of the House of Commons.

The works now cover 300 acres; the workshops and forges 50 acres; and the mines yield annually 250,000 tons of coal and 300,000 of iron ore; 300,000 tons of coal and about 120,000 tons of ore are purchased. The iron-works produce more than 100,000 tons of iron, besides machinery, locomotive and marine, iron bridges and viaducts, and even iron gunboats and river steamers, of an average yearly value of £600,000. The pay-sheets return 9,950 work-people, and wages amounting to £370,000 per annum; and the steam-engines are equal to a duty of nearly 10,000 horse-power. These marvelous works have therefore been virtually created in thirty years, and in fact, the well-built, well-paved town of Creuzot, with its churches, its schools, its markets, its gas and water-works, and its handsome public walks, inhabited by nearly 24,000 well-fed and decently-clad people, has taken the place of the wretched pit village of 2,700 inhabitants in 1836. There is no overcrowding, the space in the dwelling houses averaging 1,100 cubic feet per head of the population. Notwithstanding his public duties, Monsieur Schneider retains the chief direction of the works. During the session of the Chamber, the immediate management on the spot is in the hands of his son, but in the recess he resides at Creuzot. After having conducted me for several hours through these vast works, Monsieur Schneider returned to his office to complete and dispatch his correspondence, and debate the most minute economical points, items of cost, and rates of carriage with the heads of departments, shewing himself, as he expressed it, "*industriel jusqu'au bout des ongles*." \* \* \* \*

To describe the works in detail would carry me beyond the limits of this report. I saw no new mechanical contrivances; the best English designs were followed; but no appliances for producing perfect work, or for economizing the cost of production, have been omitted; and the new forge, contained under a single roof, 1,300 feet in length and 310 feet in breadth, is probably unequalled in the world. A very large proportion of the *personnel* of every rank in this great establishment was born and has been trained on the spot, and the possibility of thus forming highly-skilled workmen, competent engineers, and accountants, is due in a great measure to a system of education, dating as far back as 1841, which, though it is modestly styled elementary, is far more advanced and "special" than the term implies. The course, not necessarily followed by all, but open to all of sufficient capacity, extends over nine years, and includes advanced instruction in French literature, history, geography, natural philosophy, the chemistry of metals, algebra, geometry, mechanical and free-hand drawing, and modeling. The more promising boys are sent to the secondary and higher technical schools, and many a Creuzot laborer's son may be found, who, having passed through the *Ecole des Arts et Métiers* at Aix, has returned to fill a responsible position in the technical management. The other boys are drafted from the school into the works, and placed there strictly according



to the capacity which they have shown at school; some as simple workmen, others as accountants or as draughtsmen. Education is not compulsory, but no Creuzot boy is admitted into the works who can not read and write, and none who has been turned out of the school for misbehavior. No doubt many of the boys, as they grow up, unlearn much of what they have acquired; it is not in one generation that the most strenuous efforts in favor of education can be expected to bear fruit, but a proof that they are not illusory as to the mass may be found in the fact that whereas amongst those employed at Creuzot, but coming from the villages or from a distance, 31 per cent. of the conscripts, on the average of the last six years, were illiterate, only 9 per cent. of those born or brought up in the town were unable to read and write. There are adult classes, less as a corrective of deficient elementary instruction than as a help to those who wish to carry their studies beyond that of the school. They are held on Tuesday, Friday and Saturday, and include, at the outset, reading, writing, arithmetic, geometry, natural philosophy, chemistry, geography, history, linear and free-hand drawing, and music. But of late years, six of the heads of departments, pupils of the Ecole des Arts et Métiers, have been appointed to teach special classes, bearing directly on the occupations of the workmen, and including, as one of the most important, a complete course of machine-drawing. Though the proportion of adult pupils here, as elsewhere, is small, 5 per cent. of the whole number of workmen, the result is that Monsieur Schneider, in walking through the sheds, where several pairs of marine engines were being erected, was able to inform me that there was not a man amongst the mechanics employed in that department who could not make an accurate drawing of the work in which he was engaged. What this signifies and is worth, a mechanic alone can fully appreciate. Of the 268 superior engineers, managers, book-keepers, &c., 127, or nearly one-half, were educated at Creuzot: 5 were pupils of the Ecole Centrale; 5 of the Imperial Mining School; 20 of the three Ecoles des Arts et Métiers; 2 of the Ecole la Martinière at Lyons; 104 of various schools. Most of the latter, however, were of middle age, and entered Creuzot when its present system was in process of creation. The schools, which were opened in 1841 with 91 children, contained 4,065 in 1866, of whom 2,219 were boys; the entire number of children in Creuzot between the ages of 5 and 15 being 4,638 at the same period. There are 11 schoolmasters, under a chief director, in the boys' schools; and the girls are taught by 11 "sœurs." The school-fees are 7d. per month for the children of persons employed in the works, and 14d. for those of strangers. Wages, though they have increased one-half during the last twenty years, are still low compared with those to which we are accustomed. They amount, on the average of the entire establishment, to 2s. 10d. per day, including the unskilled laborers and boys. The average wages of those employed at the mines and coal-pits are 2s. 8d.; at the forges, 3s.; at the blast-furnaces, 2s. 3d.; and in the workshops, 2s. 9d.; but the more highly-skilled mechanics will earn as much as 6s. 6d., and the puddlers from 6s. to 9s. 6d. per day. The lowest wages of the latter, according to the pay-sheet exhibited at the forge at the time of my visit, were 5s. 6d., and it is worthy of observation that whilst in nearly every department the working staff is recruited among the children of the work-people, they are averse to the rude task of the puddling furnaces, in spite of the attraction of high pay; so that in this branch the labor is imported generally from the surrounding villages, boys being taken into the forge at the ages of 16 and 17, when their frames are approaching maturity. But the tendency of modern improvements is to substitute mechanical and chemical processes for such work as that of puddling; and it will probably not be long before it is superseded. Meanwhile the employment of children of tender years during the night is almost entirely dispensed with. Girls under 17 are never admitted; women do not work below the surface as they do in Belgium; and the few females in the works, only 4 per cent. of the whole, are employed in the light day-work of dressing ores and similar occupations. Boys scarcely ever enter the works before 14. Every person is paid immediately by the proprietors, and nearly all by the piece or the ton. The ruinous system of contracts with middlemen, pursued in our iron-works, is unknown. There are no "butties," no forge contractors earning their £2 per day, no "underhands" paid by puddlers; the humble laborer comes into personal contact with the



managers, and his work is appraised by men of education and paid for according to its relative value. Tables showing the actual daily earnings of every man are suspended in the workshops of the several departments, so as to be open to the inspection, and to stimulate the emulation of all.

In reference to the moral condition of the population, I will simply state that during fifteen years, the entire number of serious felonies in the town of Creuzot was 23; but of these, only 9 would have been felonies according to our law. The number of misdemeanors was about 40 annually; but many of these would not have constituted breaches of the law with us; amongst others I may mention simple bankruptcy, maiming to escape military service, and abusive language. I was told that three policemen form the entire preventive force. Drunkenness is rare. I certainly did not observe a single case during my visit. That the people are frugal appears from the amount of their savings: £97,500 deposited by 540 persons employed in the works; £212,000 the value of freehold property at Creuzot belonging to those so employed; £130,000 of the same belonging to those formerly employed; £94,000 belonging to strangers.

#### SCHOOL FOR PRINTED STUFFS AT ROUEN.

The Art School of Rouen was instituted in 1742, to aid in perfecting a local industry, and has since been continued in the interest of one of the staple manufactures of the town, *Indiennerie*, or printed stuff, such as chintz.

It has a two-fold character: the classes for general art instruction, as the elementary, the antique, the living model class, and the class for *l'Indienne*, are held in the afternoon between 12 and 5; and the practical classes for workmen, in geometry, machinery, and construction, between 8 and 10 in the evening.

#### SCHOOL FOR THE SILK MANUFACTURE AT LYONS.

The School of the Fine Arts at Lyons was established with a view to advance the silk manufacture, by training designers and artists in flower painting and grouping, and in color ornamentation generally. This object is not lost sight of, although this has ceased to be a leading object of the Academy.

#### WEAVING SCHOOL AT MULHOUSE.

The weaving school at Mulhouse teaches the general theory of weaving, and its application to all the various branches of the art. It is under the patronage of a local society of industry, and is governed by a managing committee.

It is open eight hours daily, with the exception of Sundays and legal holidays. There is also a special course of two hours every day for journeymen. The course is theoretical and practical; the theoretical part including the study and the analysis of the structures of fabrics, with especial reference to the wants of the district, drawing patterns and plans of machines, estimating the cost of material and finished goods, bookkeeping, &c. The practical part consists of the mounting, arranging, adjusting, repairing and keeping the machines in good order, including the steam apparatus, besides going through all the processes, including preparatory operations. All the instruction is given to each pupil separately, and in the practical part by skilled workmen.

There is an examination at the close of the course, and certificates are given to those who have deserved them by industry and good conduct.

The fees are three hundred francs each for the practical and theoretical courses, and twenty-five francs monthly for the special course.

The school is fitted up as a manufactory, provided with steam-power, repair shops, and all varieties of machines and models, and provision is made for trying experiments with new machines or new processes.



# SPECIAL SCHOOLS AND INSTRUCTION

IN THE FINE ARTS, AND IN DRAWING.

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## INTRODUCTION.

THE Imperial Schools of the Fine Arts in France originated in the Academy of Painting and Sculpture, which was founded by royal decree, January 20, 1648, on the application of LeBrun, Sanagin, Corneille and others, and incorporated by letters-patent in 1655, and endowed with an annual grant of four thousand livres in 1663, through the influence of Colbert. The corporation originally consisted of a protector, (the first was Cardinal Mazarin,) a director, a chancellor, four rectors, four assistant rectors, a treasurer, four professors, (one of whom was professor of anatomy, and another of geometry,) a historiographer, secretary, and two ushers.

Every day for two hours in the afternoon, the painters held a public assembly, to which young artists under certain regulations resorted to design and paint, and the sculptors to model. There were twelve professors who had each charge of the school for a month. The professor on duty set the copy, subject, or model for the month. In one week two models in the sculpture hall were set, which was called setting the group. And the paintings and models made after the professor's copies, model, or group, were called academic figures, or productions. Two prizes for drawing were distributed every quarter among the students, and four others, two for painting and two for sculpture, were competed for once a year.

To encourage and form artists still further, Louis XIV, in 1670, established at Rome a school or academy of painting and sculpture, wherein those who gained the annual prize at Paris, were entitled to a subsidy from the King to maintain them at Rome for three years, in a building provided expressly for their accommodation by the academy.

In 1671, the Royal Academy of Architects was instituted by the same great minister, (who was also the founder of the *Academie des Inscriptions et Belles-Lettres*, in 1663, and of the *Academie des Sciences* in 1666, which received the royal ratification in 1669.) In these academies, variously modified and even suspended and abolished, we find the origin and even prototypes of the existing

state schools of the fine arts in France, which are now under the administration of the Minister of the Imperial Household and the Fine Arts.

The following appropriations were made by the government for the art schools in the department of the Minister, in 1867 :

For the French Imperial Academy at Rome, staff, apparatus, and repair of buildings, 167,000 francs.

For the Imperial and Special School of the Fine Arts, for the same expenses, 220,000 francs.

For the Imperial Special School of Drawing and Mathematics, for the same expenses, 58,000 francs.

For the Imperial Special School of Drawing for young women, for the same expenses, 14,000 francs.

For the Imperial School of Fine Arts at Lyons, staff and apparatus, 47,000 francs.

For the Imperial School of the Fine Arts at Dijon, for the same expenses, 15,000 francs.

The Budget for the year 1870 contains the following, among other items, in addition to the provision made for the above special schools of the fine arts.

For the decoration of public monuments, 520,000 francs.

For the purchase of works of art, and casts, 14,000 francs.

For the annual exhibition of works of art, 24,400 francs.

For the preservation of ancient historic monuments, 880,000 francs.

For the works of art, and art ornamentation of public buildings, 1,082,640 francs.

#### SCHOOLS OF THE FINE ARTS.

The Imperial School of Fine Arts at Paris was organized during the period of the Republic (Jan. 23, 1803,) and received its present constitution by an Imperial decree, bearing date Nov. 13, 1863.

It is open to French citizens only, the requisites being to make their desires known, and to prove their French citizenship; they are not to be under fifteen nor more than twenty-five years of age. Foreigners are admitted to the course of study on receiving special permission from the Minister, but they are not allowed to compete for the grand prize of which we shall speak hereafter.

The school provides for the study of painting, sculpture, architecture, and engraving on copper-plate, medals and precious stones, three ateliers being occupied by each of the first three classes of students, and two by the engravers, one of which is assigned to the engravers upon copper-plate, a provision indicating partly the relative number of students in each branch, and partly the degree of importance attached to instruction therein. These ateliers are under the charge of artists having the title of *Les professeurs chefs d'atelier*.

Besides the work done in the ateliers, the following courses of theoretical study are prescribed under other professors, viz :



1. History of art and æsthetics.
2. Anatomy.
3. Perspective.
4. Mathematics.
5. Descriptive geometry.
6. Geology, physics and elementary chemistry.
7. Strength and cost of materials, superintendence and accounts. *Administration et compatibilité, construction et application sur les chantiers.*
8. History and archæology.

These courses are obligatory, but not equally so upon all.

All must pursue the courses upon history, æsthetics and archæology. The students of painting, sculpture and engraving are required to study in addition, anatomy and perspective. The students of architecture can omit the course upon anatomy.

Besides the professors already mentioned, extraordinary instruction upon subjects connected with art is occasionally given by persons not connected with the school, on receiving permission.

Connected with the government of the institution are a secretary, an *agent comptable*, a conservator of models and works of art, and a librarian, all nominated by the Minister and placed under the immediate authority of a director, appointed by imperial decree for a period of five years. The director alone has charge of the execution of all regulations, corresponds with the administration upon the affairs of the school, and controls the funds.

Besides these officers there is a superior council (*conseil supérieur d'enseignement*), of which the professors having charge of the ateliers can not form a part. It is composed of the superintendent of fine arts, who is its president; the director of the administration of fine arts, the vice-president, and certain professionals appointed by the Minister, namely, two painters, two sculptors, two architects, an engraver, and five other members. It performs its functions gratuitously, and one-third of its members retire every year, although the retiring members can be immediately reappointed.

The director receives 8,000 francs yearly. The professors receive a salary of 2,400 francs, in addition to which the professors placed over the ateliers are provided with studios at the public expense.

*French Academy at Rome.*

The great feature for the encouragement of the study of the fine arts is the opportunity of a residence at Rome, (*grand prix de Rome*), which is open to competition not only to members of the school, but to all French citizens between the ages of fifteen and twenty-five. Members of the school can also compete without being compelled to study for any specified time, so that no obstacle is put in the path of the more energetic and those inclined to make

rapid progress. Three examinations are held in the school annually, for painting, sculpture and architecture, every two years for the engravers upon copper-plate, and every three years for the others. After two examinations, the best ten in each class are selected for a final examination for the great award, the successful aspirant to which is sent to Rome, (*grand prix de Rome*,) the mode and programme of all the examinations being drawn up by the superior council. This council selects also a list of names of judges for each class, which list is presented to the Minister, who chooses from it the five juries of award, consisting of nine members for each of the three classes, painting, sculpture and architecture, and five members for each of the other two classes, the engravers of medals and precious stones forming one class. Each jury passes judgment upon one class only, the results of both the preliminary and the final examinations being laid before it. Hence the result can not fail to be more fair than if the decision depended upon one examination alone.

The successful aspirants, one in each class, are now sent to Rome, where they are obliged to remain two years, after which they can travel two years longer, following their own tastes, but must previously notify the administration of their intentions. During these years they receive a regular annuity from the government. An exception is made however for the fifth class, the engravers of medals and precious stones, who receive this annuity only three years, and must remain at Rome for the same length of time as the others.

During the stay of the students at the school a regular report of their progress is made every three months by the professors placed over the ateliers, to the director, who transmits these reports to the superior council. If any of the students appear to possess unusual talents, they are recommended by the council to the Minister as deserving particular encouragement.

A report of the progress and occupations of the prizemen is made to the Minister every six months by the director of the imperial academy at Rome.

#### IMPERIAL SCHOOL OF FINE ARTS AT LYONS.

The Art School at Lyons was instituted with especial reference to the needs of the industrial arts, and particularly for those who are to be employed in designing for the silk-looms of the city.

The school is placed under the supervision of a director appoint-



ed by imperial decree,) whose office is properly only executive. His duty is to supervise the work of the professors and the scholars, and he is responsible for the archives, models and other apparatus belonging to the institution. He is ordered to allow no change in the prescribed mode of instruction, this being carried so far that he must prevent the use of any models except those furnished and recognized by the school. All infractions of these rules must be by him reported to the prefect of the Rhone, he himself having no power of punishment over the pupils, beyond fifteen days' suspension. Under his orders are the secretary, the monitor, whose care it is to see that all the pupils are present and orderly, and the janitors and porters. The professors are not subject to his orders, although they are to look to him to supply their places in case of their absence.

The director and professors form a council of administration, presided over by the prefect or his substitute, holding its meetings once a month. The secretary is present, but simply as a clerk. The most important duty of the council is to decide upon the degree of advancement arrived at by the students, in order to classify them properly. But their decisions are not valid without the signature of the prefect himself.

The branches taught are the following:

- Class 1. Elementary drawing and drawing from the antique.
- “ 2. Drawing from the living model.
- “ 3. Painting from the living model.
- “ 4. Sculpture and ornament.
- “ 5. Architecture and ornament.
- “ 6. Engraving upon copper-plate, wood, and stone.
- “ 7. Drawing and painting in water-colors from flowers.
- “ 8. Composition applicable to manufactures.
- “ 9. Course of perspective.

The third class, and the painting of flowers in oil, are optional. But the study of the human figure, being useful in both art and manufactures, is required of all. The painting of flowers in water-colors is especially directed to the benefit of those who are to be engaged in drawing patterns for the manufactories.

To become a pupil of the school, the applicant must be of French birth, must have completed his twelfth year, and must be able to read and write, besides having some elementary knowledge of arithmetic. It is also required that he have been vaccinated, unless he has had the small-pox. If his parents are not residents of Lyons, he must find some citizen to be responsible for him.

No foreigner or child of foreigners can be admitted, except by written permission from the prefect, and until recently such were

not allowed to contend for the prizes. If there are more applicants than can be admitted, those are preferred who intend to become draughtsmen in the silk manufactories of the city. If the applicant is somewhat advanced, he is permitted to enter an advanced class, but must first execute one or more designs under the eye of the professor of the class into which he desires to enter. These drawings are presented to the council, which decides upon his petition. Before this council are brought such designs executed by the newly-admitted members as the professor of the elementary class selects for that purpose, and the council decides whether those who have drawn them shall be admitted into the school; a regulation designed to prevent the admission of all not endowed with sufficient talent to profit by the instruction.

The academical year begins on the 1st of November and continues to the 15th of August, being closed upon Saturdays and certain other holidays. The school opens at 9 and closes at 2 until the 1st of March, when it opens and closes an hour earlier. Students fifteen minutes late are not permitted to enter, but are considered absent, as are also those who leave before the school closes, and two absences in the same week are punished with suspension, unless sufficient excuse is given.

Fifteen days of unnecessary absence may be punished by expulsion. The hours of work are to be passed in silence, and no one is allowed to visit a student while in the school, without special permission from the director.

There is an annual distribution of prizes, for which every pupil is obliged to contest, on pain of expulsion from the school, unless excused by the director. The programmes and modes of examination are drawn up by the professors of each class and presented to the council, being subject to modification by them, after which the prefect approves of them and they are posted up in the school. The work upon the subjects proposed is now performed in the ordinary school hours upon paper furnished and signed by the professors and director, and no models or sketches relating to the work in hand can be brought into the room. Those studying architecture are however allowed to work from five in the morning until night on the day when their work is to be finished.

Work on these is to be finished on the last day of the term, and the sketches are to be signed on the back, the signature being well covered so that the name can not be read without tearing the paper over them.

A jury of three members for each class decides upon the merits



of these sketches and sends in a sealed report to the director, only to be opened on the day when the prizes are distributed.

A singular provision of the law forbids the insertion in this report of any theoretical observations upon the methods of teaching, the progress of the students, or the fitness of the professors. After the distribution of the prizes the successful sketches are exhibited to the public for two days, and then hung up for a year in the school rooms and pass into the archives of the institution.

We will now enter into a few details upon part of the programme of studies already given.

Five evenings in the week, from November 1st to April 1st, for two hours, between six and eight, all the students are required to draw from the nude model, a privilege to which the director can also admit any one not a member of the school.

The *pose* is given to the model by certain professors, each of whom decides the position for a month, when he is succeeded by another.

As there is much choice in the places of drawing from the model, the best places are given to those students who have taken gold medals in the school. The others are assigned by order of merit in an examination held for the especial purpose, in which all contend, except the elementary class.

Absence from this session is punished with the same penalties as absence from the morning session.

Perspective is taught by a weekly lecture of an hour's duration, from eight to nine in the morning, and by practical exercises from eleven to one, of the same day.

The course is obligatory upon all the students of the elementary class, no one being allowed to enter a higher class without a certificate from the professor of perspective. Exceptions are sometimes made by the council, but even in this case the student is obliged to take this course with the lowest class.

There is an annual prize, for which are entered the portfolio of exercises on perspective made during the year, and a design upon a given subject, made in two days under the supervision of the professor.

Descriptive geometry and stereotomy are taught in weekly lessons, between half-past six and half-past nine in the evening, and are obligatory upon all the students of architecture. At the end of the year the portfolios and a plaster model of a given section of stone are entered for a prize. Absence from this course and that on perspective is punished as in previous cases.

Practical geometry is also taught in weekly lessons, between eight and nine in the morning, and the pupils are exercised in the field in surveying and in making plans.

Prizes are given for the best books of exercises, and after an oral examination all prizes of the school are delivered at the same time.

Besides these courses there is given in the amphitheatre an annual course of lectures upon comparative anatomy, as applied to the fine arts. These lectures, which are open to the public, are given twice in the week, between three and four in the afternoon. They include a demonstration of the most remarkable anatomical arrangements of man and the inferior animals, with special reference to motion and to the anatomy of expression, and are illustrated by the study of living models. The physiological phenomena involved are explained. This course is concluded by a profound comparison, in regard to form and expression, of the principal productions of the fine arts, such as pictures, bas-reliefs, statues, &c.

#### ART SCHOOL AT DIJON.

The Art School at Dijon was instituted for the study of the fine arts in general, and without regard to any particular practical end.

It is open five days in the week, from November 1 to August 15.

Its curriculum presents the following annual courses :

1. Drawing from prints.
2. " " bas-reliefs.
3. " " the nude and models.
4. Painting.
5. Sculpture.
6. Architecture.
7. Perspective.

Lessons upon perspective are given by the professors of architecture, and all the pupils are obliged to attend them. During the months of May and June they are discontinued, and their places are supplied by lessons upon anatomy, in connection with design, given by some one of the physicians of the city.

Particular attention is given to rendering the pupils familiar with the use of the stump, chalk, and drawing in sepia.

As in the other art-schools there are annual prizes to contend for, which is however optional with the students.

Prizes are given for excellence in the following branches, among others : historical and *genre* composition, copying prints, drawing heads, designing ornaments, and copying architectural designs. The prizes consist of two medals in each class and are adjudged by artists and amateurs, invited by the director for that purpose.



## INSTRUCTION IN ARCHITECTURE.

The education of architects, during the middle ages, was left to the guilds, into which the aspirant entered as an apprentice, gradually working his way up to the position of master-builder, for the two positions of designer and master-builder were not then divided. But in course of time the guilds, never purely industrial organizations, became more and more inefficient, and influenced by politics and religion, and it was with the intention of providing elsewhere an education for architects, now becoming a distinct body, that the Academy of Architecture was incorporated in 1671, at the suggestion and efforts of the great Colbert. After various vicissitudes in the revolutionary period, it was reorganized on its present basis as a separate section in the Academy of the Fine Arts in 1816.

*Section of Architecture.*

THE ARCHITECTURAL SECTION of the Special School of Fine Arts at Paris comprises two divisions. To obtain admission to this section, it is necessary to pass an examination, which is held twice during the year. After admission, the pupil can, at will, pursue the whole course in one or two sessions.

Candidates are examined upon arithmetic, including decimals, weights and measures, square root and logarithms; algebra as far as equations of the second degree and proportions; elementary geometry, plane and solid; descriptive geometry and universal history, with reference to the development of art.

The courses pursued in the school are as follows: Trigonometry; conic sections; mensuration and surveying. Statics, on the parallelogram of forces, centre of gravity, and machinery. Physics, on weight, heat, electricity and magnetism, acoustics and optics. Chemistry, its elementary laws, the principal elements and compounds. Descriptive geometry, of straight lines, planes, and curved surfaces. Perspective, of straight lines, surfaces and shadows; scales of perspective; abstract and applied problems in drawing up perspective designs and in calculating distances, angles, and points of sight from designs already made; circles in horizontal or inclined planes, cylinders, cones, spheres, and salient surfaces of various orders of curves, the whole course on perspective closing with various problems. Stereotomy; stone vaults of the different forms, stone apertures and stone stairs; carpentry.

Construction;—theoretical, including the discussion of the various forces, resistance of materials, and the stability of structures;—practical, on the natural and commercial history of the stones, woods and metals used in building or in decoration, the forms given to them in the arts, their strength, defects, and the accidents to which they are liable, and the means of preserving them.

The various structures, or parts of structures, formed by each are studied, and the historical development of the art. Thus, of stone are formed piers, columns, entablatures, stairs, roofs, ceilings, vaults, inverted arches, tunnels, terraces, dykes, and roads; of wood, blinds, sash, floors, stairs, roofs, and bridges of various dimensions; of iron, bolts, rivets, balustrades, columns, arches, trusses, girders, roofs, stairs, and large bridges.

The classes of workmen employed for each, and the tools used by them, are

also described, including the putting up of scaffolding, masonry, carpentry, lock-making, and founding.

Finally, foundations of all descriptions, including those laid in water, are studied, with the various accidents to which they are liable.

#### CENTRAL SCHOOL OF ARCHITECTURE.

THE CENTRAL SCHOOL OF ARCHITECTURE, in Paris, was established in 1865, on a foundation of 400,000 francs, is under the management of Directors elected by the subscribers to the fund, but is subject to the supervision of the Ministers of Public Instruction and of the Fine Arts, both of which have created scholarships and half-scholarships which are competed for by the pupils of the school, and are represented in the commissions which conduct the admission and competitive examinations.

The school is situated in the Hotel de Chaulnes, in Rue d'Enfer. Its object is to supply a sound practical education in aid of existing institutions, which give more of the artistic qualities of an architect's education.

The school is open to foreigners as well as natives. The fee for the annual course is 850 francs, payable in three instalments, namely, 400 francs on admission, 250 francs on the 10th of February, and the remainder on the 10th of May following. In addition to this, each pupil deposits 40 francs to cover any losses or damage occasioned by his fault.

The examination takes place in November, either at the school itself, or in any provincial town, or before a professor of any foreign university, if not a native. Those pupils who do not exhibit sufficient aptitude or assiduity for success, are not allowed to continue in the school. At least one-third of the candidates fail, and nearly the same proportion admitted prove incompetent.

Candidates for admission, if examined in Paris, are required to send in a drawing of an ornament in bas-relief, the plan, section, and elevation of a building; and a written composition; these are replaced, in the case of provincials or foreigners, by certificates of local architects. In all cases the candidates are examined orally in the following branches of knowledge: arithmetic, including fractions, decimals, the metrical system, roots and powers; algebra, including simple equations, negative quantities, roots and powers of algebraic expressions, radicals of the second degree, equations of the second degree, and questions relating to compound interest and annuities; geometry, plane and spherical, with problems; trigonometry; descriptive geometry, conic sections, curved surfaces and plane sections; geography, distribution of sea and land, zones, elements of ethnography, political geography of Asia, explaining the revolutions which have successively changed the geography of China, Tartary, India, the Greek and Mussulman dominions in India, the Assyrian, Persian, Macedonian, Roman, Arab, and Ottoman empires in Western Asia, Phœnicia, Judea, and Egypt; political geography of Europe; revolutions which have changed the distribution of nationalities in the West; maps of Greece and of her colonies in the time of Pericles, of the empire of Alexandria, of the Roman empire under Augustus, and of the empire of Charlemagne; Mussulman dominion during the Khalifat of Cordova; and lastly, Europe in 1453, 1648, and 1865. Candidates who have already made some progress in architectural studies are invited to submit their drawings or compositions to the examiners, who will take them into consideration as evidence of capacity.



## INSTRUCTION IN INDUSTRIAL DRAWING.

The artistic superiority in form, color, and finish, universally accorded to the commercial products of the workmen and factories of France, until quite recently, is to be attributed mainly to the general feeling for art which pervades all classes in that country, which the churches and other public and private edifices, erected and ornamented from designs of professional painters, sculptors and other artists, have fostered; and to the influence of the numerous galleries and collections of pictures and statuary, the master-pieces of the most eminent ancient and modern artists, in stone, ivory, glass, wood and metal, freely opened and actually visited by workmen as well as other citizens. To these agencies must be added the influence of the workshops established and aided by the government, such as the great factories at Sèvres, the Gobelins and Beauvais; and of the higher academies of the fine arts, at Paris, Lyons, and Dijon, and the numerous schools of drawing and design in all parts of the country.

Within the last ten years the importance of multiplying schools of design for training artistic and skilled workmen for every department of manufacturing and mechanical industry, with a view of maintaining the superiority of the workshops of France, has been pressed on the attention of the government. This is due to the International Expositions of London and Paris, which showed the rapid progress made by other countries in departments of labor in which France had before held an uncontested superiority.

The Report of Professor Wornum to the English Department of Practical Art in 1853, "on the organization and character of the Art Collections and systems of instruction in Schools of Design in Paris," rudely exposed the want of system, both in these collections and in the Schools of Design for Working Men—rich as these collections and numerous as these schools were. The Reports of Commissioners deputed by the French Government, and the municipal authorities of Paris, Lyons, Mulhouse, and other cities, on the Expositions of 1856, 1862, and 1867, showed the necessity of immediate attention to the subject.

M. Chevalier, in the Introduction of the Report of the French Juries in 1863, warned the nation "that rivals were springing up, and that the prominence of France in the dominion of taste will ere long receive a shock. While we are stationary, others are rising; and this upward movement is nowhere more conspicuous than in England, in consequence of the attention of the government to Schools of Design." M. Rouher, the Minister of Commerce, Agriculture, and Public Works, in a report to the Emperor in 1863, calls "for the appointment of a Commission to inquire into all the means which may spread and develop artistic skill and professional information every where, even in the agricultural portions of the empire. This Commission was appointed, and after a thorough investigation into what had been done and was doing in France and other parts of Europe, recommended: (1,) Better and more general preparatory instruction of all classes; (2,) The protection of young persons from the cupidity of parents and the greed of capitalists, by their too early employment in labor; (3,) Provision for special technical instruction for all young persons, both boys and girls, engaged in workshops; (4,) The establishment of special courses for adults, and particularly of drawing, in all its forms and applications; (5,) The formation of collections of models and copies in all the great industrial centers, and especially of a Museum of Industrial Art, at Paris; (6,) The establishment of higher institutions and special courses of technical instruction.

## SPECIAL SCHOOL OF DRAWING APPLIED TO THE INDUSTRIAL ARTS AT PARIS.

This school was instituted in 1835. The office for entering names of new scholars is open every week-day from 10 A. M. till 4 P. M. The entrance-fee is 5 francs 50 centimes for the morning course, and 25 centimes for the evening course. The conditions of admission to the former are: age 9 years, knowledge of reading and writing, and to the latter, 15 years of age. The morning classes commence at 7.30 A. M. in summer and at 8 A. M. in winter. The study is divided into 2 divisions of 2 hours each.

The evening classes for adults commence at 6.45 P. M. and close at 9 or 10 P. M., when there are courses of anatomy and ornamentation.

For the modeling classes and the study from living models there is instruction once a week in the evening. No one is admitted who is younger than 12 or older than 20 years. The course for scholars older than 15 years covers 4 years, that for scholars younger than 15 years, 5 years.

The morning course embraces the following subjects: geometry, rectilinear and applied trigonometry, perspective, arithmetic and algebra; geometrical drawing, drawing of plants, drawing of animals, drawing of figures, drawing of ornaments; sculpturing, drawing from nature and models.

The evening course embraces the following subjects: arithmetic; geometry; geometrical drawing; architecture; anatomy; drawing of figures, animals, ornaments, and plants; composing of ornaments; wood-engraving.

We have no details as to attendance or methods.

## SCHOOL OF DRAWING FOR YOUNG WOMEN IN PARIS.

The School of Drawing for Young Women (*Ecole Speciale de Dessin pour les Jeunes Personnes*) in Paris, is situated on the Rue Dupuytren, in the Faubourg St. Germaine. Its purpose is to give instruction in all varieties of drawing of figures, ornaments, scenery, animals, and flowers. The directrix of the school, who is also the professor, is Mademoiselle Marandon de Montyel. Mademoiselle Rosa Bonheur is ordinary directrix. There is an annual *concour*, when prizes are distributed, consisting of silver medals, the best pupil receiving the *grand prix d'honneur*, a large medal with a diploma. The pictures presented at the *concour* are exhibited, either previously or afterwards, in the halls of the school. This school and the Special School of Drawing belong to the department of the Minister of the Imperial Household and Fine Arts.

*Supply of Plaster Casts.*

There are at Paris two public establishments where plaster casts are made and sold. One is at the Louvre, where casts are taken from the antique statues in that collection, and the other is connected with the *École des Beaux Arts*, where casts are made of every description, particularly of ornamental and architectural fragments. The council of the school appoints a molder and assigns to him all the necessary rooms free of charge, and pays half the cost of materials and workmanship, agreeing to reimburse him in case any particular cast does not sell well enough to leave a reasonable profit, receiving, on the other hand, one-fourth of the proceeds. The objects to be cast and the tariff of prices are to be fixed by a Committee of Academicians, with which the molder is associated. Copies of these casts are distributed to all the art schools in France.



## PRIMARY SCHOOLS AND NORMAL SCHOOLS FOR PRIMARY TEACHERS.

To secure the introduction of drawing into elementary schools generally, Guizot, in his course of studies for the seminaries in which the primary teachers were to be taught and trained, provided for their instruction in drawing; and so important is the branch now considered, that special professors of the highest reputation have been appointed to impart it.

## MUNICIPAL SCHOOLS OF PARIS.

In 1863, a plan for the reorganization, the extension and improvement of instruction in drawing in Paris, was submitted by a Commission, of which M. Dumas, President of the Council, was chairman. This plan was accepted, and the necessary appropriations and regulations were made. Instruction in this branch is now obligatory in all public schools of every grade, for girls as well as boys. Teaching this branch is made a recognized profession, to practice which a diploma is granted only after an open and searching examination. Every school must have the models and copies provided and recommended by the highest authorities in art. Prizes are instituted, open to all the schools, and professors are paid in part in proportion to the number of prizemen who are trained by them. The awarding of these prizes is made the occasion of public interest and instruction.

*Progress of Instruction in Drawing in Paris.*

In 1867, drawing was taught in 120 primary schools for girls, and in 65 schools for boys, and in 32 special classes for adults; 7 schools are maintained by men for male pupils, and 20 by ladies for gratuitous instruction to girls. Upwards of 35,000 copies of models from the collections of the Louvre, and numerous photographs of ancient classic statues made by M. Ravaisson, have been distributed in the schools of Paris. The appropriations by the municipal authorities have increased from 30,000 francs in 1863 to 312,000 francs in 1867, and the pupils from 2,888 to 12,000.

## DRAWING IN SECONDARY SCHOOLS.

In 1853, under the ministry of M. Fortoul, on the recommendation of a special commission, of which M. Ravaisson was the reporter, and composed of eminent artists and educators, the study of drawing was made general in all lyceums, commencing in the sixth class, and extending from year to year to the end of the course.

By the terms of the decree, (Dec. 30, 1853,) all the models were to be selected from the master-pieces of art; and a beginning was at once made by distributing such models selected from the copies taken in plaster in the department "du Moulage" of the Museum of the Louvre, and the "Atelier du Moulage" of the School of the Fine Arts. In 1865, M. Ravaisson presented to the minister (M. Duruy) for his approbation, which was promptly given, two divisions of a collection of models from modern and ancient artists, which, disposed in a progressive order, and faithfully reproduced, offer for study and imitation the *chefs-d'œuvre*, in which sculpture, glyptics and painting have attained the highest degree of perfection, and which will be, in art, what our instruction in letters and philosophy is, the reunion of the master-pieces of the Homers, and

the Platos, the Virgils and the Terences, the Descartes, the Bossuets, the Corneilles, of different epochs.

To give to this branch an assured position in the system of public instruction, a decree of Jan. 31, 1866, approved by the Minister of Finances, extends to the teachers of drawing a retiring pension at sixty years of age, and after thirty years of service.

#### PROGRAMME OF INSTRUCTION IN DRAWING IN LYCEUMS.

1. *Imitation and Free-hand Drawing.*—This commences in the sixth or lowest class, and is attended to at different hours on different days. In the fifth and sixth, one hour per week is devoted to preparatory exercises. These are designed, first, for the imitation of simple figures, such as some of the regular solids and some parts of vegetation; second, some portions of the head.

In the fourth class there are two lessons per week; first, on the theory and practice of the elements of perspective; second, the elementary study of the human form and its proportions, with reference to drawing; third, drawing of parts of the head and then of the entire head, from photographs or pictures.

In the second and third classes, two lessons per week are given in drawing of the head and limbs, from pictures, photographs, or from a bust.

In the classes in rhetoric and philosophy, there are two lessons per week in drawing of *torses* and casts from pictures, photographs, or busts. One lesson each two weeks is given to the third class exclusively, in drawing artificial forms, edifices, vases, and ornamental furniture of all kinds.

Toward the end of the last year of the course, the pupils reproduce certain ornamental patterns in color. During the year of special mathematical study, the pupils are required to produce with rapidity and accuracy casts shaded with the crayon, from a model. These models are all lent to the great art masters. They are not used in the drawing classes only upon the approval of the Minister of Public Instruction. Pupils are to apply themselves to drawing the human figure, as well as that of artificial forms; and with the same result; and of these, the memory should reproduce the types most deeply engraved in the memory. At the close of each year, pupils are required to exhibit a certain number of sheets of drawings, the whole of which should constitute a full course in drawing.

2. *Linear and Geometrical Drawing.*—In the third class, during the second half-year's course, two lessons of one hour each are given each week in linear drawing, in Indian ink, and in elementary geometry. During the whole year, two lessons of one hour each, or one of two hours per week, are given to exercises in linear drawing in the second class, and the classes in rhetoric and science.

In the second class, these exercises relate, first, to elementary geometry and the outlines of polyhedrons; second, to drawing of plans, from works executed in the earth; third, plans from descriptive geometry.

In the class in rhetoric, these exercises embrace, first, a representation according to a plan, cut or elevation of a building, of a machine or some instrument in accordance with a certain measure of the objects, and reduced by a certain scale; second, geographical charts; third, leveling (profiles of curves and elevations from surveys taken on the ground.)

During the year in the class in philosophy, the students in the scientific section are exercised two hours per week in linear drawing.

Students in the class in special mathematics are exercised in linear and geometric drawing, and with India-ink, after various copies.

The course of instruction in drawing in the primary and secondary schools was severely criticised in a late conference of teachers and directors of art-institutions, held under the auspices of the *Union Centrale*.



## PROGRAMME OF CALLIGRAPHY AND DRAWING IN SPECIAL SECONDARY SCHOOLS.

The following programme of instruction in calligraphy and drawing is taken from the very elaborate directions drawn up and issued by the Minister of Public Instruction for the four years' course (including the preparatory year) of the special secondary schools recently organized in France.

*Preparatory year or course.* During this year four hours weekly are devoted each to calligraphy, and drawing, or eight hours to both.

**CALLIGRAPHY.**—Commerce and industry demand, with right, a good handwriting of the persons they employ. In the schools for special instruction, the handwriting of the pupils will be the object of particular care; there will be four writing lessons in the week. As the art of symbolizing words by the use of conventional characters is a purely imitative art, in order to hasten the progress of the children, those whose writing is defective should be mixed with those who write better. During the first years the length of the tasks given should be limited, so that the master may exact a very careful execution, and so that every task should be an exercise in calligraphy.

Instead of giving as copies, insignificant and disconnected phrases, a series of moral maxims should be composed, and expressed in a way easily retained in the memory, or very short fragments relating to industry, to history, or to the natural sciences. The pupils should collect these copies into books, which they will, perhaps, at future periods, consult with pleasure.

**DRAWING.**—The pupils of the special schools should learn to handle the pencil as well as the pen. Only on this condition will they acquire that firmness of hand and correctness of eye which will be of so much importance to them in their future careers.

As among the pupils who frequent these schools there will be future foremen, to whom a knowledge of the use of the rule and compass is indispensable, the lessons in free-hand drawing should alternate with exercises in linear drawing.

These exercises should be made on the board with wooden instruments, foot-rule, square, &c. The subjects of study will only admit of two dimensions, and should be chosen so as to enable them to be constructed with the help of a few simple data. To join two straight lines; to develop a broken line; to trace perpendiculars and parallels with the compass; the division of straight lines; proportional lines; construction of a scale of proportion; division of arcs and angles, &c.; horizontal and vertical lines; the diagonal of the square, octagons, starred polygons, &c., &c.

Free-hand drawing, which should occupy the greater part of the time, should comprise parallel straight lines, and curved lines parallel to each other, the division of lines into equal parts, measured by the eye only; the first outlines of the face, the veins in leaves, very simple architectural roses (*rosaces*), the stems of plants, some animals, &c., &c. A series of well graduated ornaments lithographed in *alto relievo*.

But it is not sufficient to train the eye to see correctly, and the hand to execute well; the taste for the beautiful, which is to direct their future artistic creations, must also be instilled into the pupils. Care should therefore be taken that the lithographs, engravings, and plaster models, given to them to copy, should always be excellent of their kind, and of simple execution, and the forms should never be concealed under unnecessary shadings (*crayonnage*.) This choice of models is of the greatest importance.

*First year.* During this year two hours are devoted to calligraphy, and four to drawing.

**CALLIGRAPHY.**—Principles and practice. English handwriting, running-hand.

**DRAWING.**—Continuation of linear drawing, and of drawing from models.

In the classes for linear drawing the notions of lines and surfaces, imparted in the course of the preceding year, should be recapitulated. Ordinary curves and conical curves should be drawn on the blackboard and explained. The exercises on paper should consist of mosaics, iron railings, balustrades, &c.



Dull grey tints and black tints spread over the drawings should continue to be practiced, as a preparation for the coloring of solid bodies.

The imitative drawing should comprise architectural ornaments, and the human face. When the pupils are to copy an ornament or a face, a model in relief, of the same size as the drawing they have to execute, should be placed in the room, in order that they may constantly carry their eyes from the board to the model, and from the model to the board, so as clearly to understand what they are about. The models of graphic exercises on paper are enclosed in frames under glass, placed in front of each pupil so as to oblige the latter to draw them without taking any measurements on the model, and merely in accordance with the dimensions indicated in the text relating to each drawing.

This branch of instruction is one of those in which the greatest latitude is left to the teacher, as the lessons ought to be given with reference to the particular industry of the province. The programmes of the course of drawing, and the choice of models, are therefore left to the decision of the members of the Council of Improvement, who alone can have a sound judgment on the matter.

*Second year.* During this year one hour is devoted to calligraphy, and five to drawing.

CALLIGRAPHY.—End of the lessons; round hand. Italian hand, models of capitals, &c., applications of divers kinds of handwriting.

DRAWING.—Continuation of ornamental and linear drawing, according to the method adopted the previous year.

Ornamental drawing. Copying figures and ornaments. Commencement of hatching to represent relief. The model from which the drawings are to be made should always be placed in the class-room.

Linear drawing: principles of the methods of projection for the representation of lines, surfaces, and solids. Representation of the relief of bodies by means of simple lines and washing in colors. Details of the practice of washing. Elementary notions of architecture, and distinctive characteristics of the principal orders.

Before commencing each architectural drawing, the pupil should make a sketch of the plan to be executed, in a separate copybook, and should carefully note down the dimension (*les cotes*). These sketches should be done in pencil, or in ink, without the help of rule or compass, and should serve for constructing the plan.

Some suitable planks should be selected to exercise the pupils in using the ruler, and the use of conventional tints should be explained to them.

*Third year.* Drawing this year. Calligraphy as a separate study is discontinued, and six hours are given to drawing.

DRAWING.—Figures from the round, and from nature. Animals and flowers from the round. Drawing from memory. Plants copied from nature.

The pupils should also be exercised in making free-hand sketches from various objects, such as physical instruments, geometrical models in relief, or very simple machines. The sketches, which should be numbered, should serve as bases of an exact representation of the objects, according to some fixed scale. The pupils are in this way rendered capable of designing tools, &c. The diagrams (*épure*s) of descriptive geometry should likewise be executed, first with free-hand, in a memorandum book, and afterwards verified and drawn exactly on drawing paper.

The pupils should also be made to draw some designs in connection with elementary mechanics, according to the lessons of the professor of mathematics, and in order to render the demonstration of the transformation of movements more evident, models of elements of machines, of the same size as the drawings, should be placed in the class-room.

We give entire the admirable Report of M. Ravaisson, Inspector General of Superior Instruction, on which the programme of instruction in drawing in the Lyceums and Communal Schools is based.



# INSTRUCTION IN DRAWING IN SCHOOLS OF ART AND DESIGN.

REPORT OF A FRENCH COMMISSION.

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The following article was translated for the Dublin Journal of Industrial Progress from the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*. (2d Sec. No. 5.) It is part of a Report, addressed to the Minister of Public Instruction in France, by a Commission consisting of MESSRS. FELIX RAVAISSON, (Inspector General of Superior Instruction,) BRONGNIART, INGRES, PICOT, SIMART, BELLOC, EUGENE DELACROIX, HIPPOLYTE FLANDRIN, MEISSONIER, JOUFFROY, DUC, and PILLET: The Reporter was M. Ravaisson.

All the Arts are learned, more or less, by practice. *Fabricando fit faber*, it has been said, and we may likewise say that Drawing is learned by Drawing.

But if it is certain that like all the arts that of Drawing cannot be learned without practice, does practice alone suffice, without any order or any kind of rule? It has been so pretended in our times, and so also even in the time of LEONARDO VINCI: "Some believe," says he, "that without other science, the practice of copying natural objects alone suffices." But he adds: "There is nothing which deceives us more than trusting in our own judgment without other reason, as experience ever proves, the enemy of alchymists, necromancers, and other simple (self-confident) spirits."

And in fact, how many mistakes of every kind does not practice without any rule, or blind routine, produce, which one must afterwards lose much time to set right? When we walk without guide through an unknown country, on the simple faith of a judgment yet unformed, and directed by nothing, how many chances are there of our losing our way! and, what is worse, having had for a long time no means of perceiving in what we are mistaken, how many chances of our contracting, from a false manner of seeing and judging, some irremediable habit! If, then, it is true that Art cannot be learned without practice, it is also true that some Theory is necessary to Practice to direct it.

"Those who are captivated by mere practice without any science, are like navigators who go to sea without rudder or compass, and who never know with certainty where they are going. Practice ought ever to be built on sound theory; without this, nothing is well done, no more in painting than in any other profession."

It is evident, in the first place, that among all the objects which can be studied, there are some the study of which is more profitable; at least, one of the first rules by which practice ought to be governed, is that which will teach it to what objects it should by preference address itself.

Of all that Nature produces or Art has ever invented, the human figure is that which it is most important to understand well and to know how best to represent, because in Art as in Nature it is to man that the first and principal place appertains. Made, among all bodies, to serve for the habitation and instrument of the Soul, to obey its will and to express its affections, the Human Body is of all that which, in its movements, in its forms, in all their proportions, presents at once the greatest variety and the greatest unity; it is that whose different types are the most strongly marked with a special character, a distinct individuality that, in fine, which is susceptible of the greatest Beauty. From this it results that errors in the representation of the human figure are more sensible than in that of any other figure, and that he that commits them recognizes them himself more easily. From hence it follows that to teach how in all things to judge of their proportions

accurately, that is to say, as we have said, to Draw, there is nothing better than to propose, as the first object of study and imitation, the human figure. It is a point upon which scarcely any difference of opinion exists.

But because the human figure is the most complicated both in its movements and in its forms, it follows also that it is of all figures the most difficult to see well and to represent well. In living nature, where to the variety of forms is added that of colors, and the mobility inseparable from life, the complexity is such that it is manifestly impossible for a beginner not to lose himself in it. Hence the necessity upon which all the world, or all but all, is again unanimous, of a simplification at first, of that which consists in giving as a model not nature itself, but an image of nature, without motion and without color; that is what is ordinarily called a *bosse* [a statue, cast, or figure in full relief.]

But does not such a figure, if it be an entire figure, offer still a whole composed of too many different elements, whose relations it is impossible for an inexperienced eye to seize and reproduce? Upon this point again, upon the impossibility of giving to the beginner an entire figure for model, no difference of opinion.

Now, there is one part of the human figure in which more even than in the remainder, the proportions are skillful and delicate, which more than all the rest possesses individuality of character, which, in fine, is susceptible of a beauty more exquisite than all the rest, and which beside forms in itself in some sort a whole, already sufficiently complicated and difficult to understand. This part is the Head.

The least simplification which it would be necessary to make, the least restriction to the hazardous essays of a blind routine, would be to give at first as models only round casts (*bosses*,) and among these only those of simple Heads.

Must we not go yet farther? Must we not give beginners for their first models, instead of round casts, prints, drawings, or photographs, where the visible appearances are more easily distinguished from the real proportions which they express, where the lights and shades are more simple and more easily understood; must we not also, instead of entire heads, make them imitate at first only the parts of which the head is composed? It is this opinion which in all times has obtained greatest credit; it is this which in all times has been generally practiced, as witness the writings of CENNINO CENNINI,\* LEONARDO DA VINCI,† BENVENUTO CELLINI,‡ VASARI,§ LONCAZZO,|| ARMENINI,¶ DE PILES,\*\* &c., as prove the collections of the *Principles of Drawing* which have been published at different epochs.†† In fine, it is this which is practiced still in our own times in the greater part of the schools, one may even say in almost all.

From all time then this principle has been generally held as true; that it is only after having learned what is easy and simple that what is difficult and complex should be attempted. On this principle the student imitates drawn or engraved figures before those in relief; the parts of a figure before the entire. Moreover, he applies himself to imitate exactly the form of whatever subject he studies, and consequently to represent with care the lights and shades which render it visible, and which determine the relative inclinations, the melting away or the relief of the surfaces.

It is complained that by this method, proceeding step by step from the imitation of the several parts of the head, after prints, too much time is required to come to the imitation of heads and entire figures from the round; it is also complained that too much time again is spent in making each drawing in the imitation of the lights, of the shadows, of the half-tints; that amidst the minutiae of this labor a vicious habit is contracted of pre-occupying one's-self to excess with details,—a habit which no longer allows one to comprehend the effect of the whole. It has been said, in short, that the result which we ought to propose to ourselves is that of

\* *Trattato della pittura*, (Roma, 1821,) 8vo. c. 8.

† *Della Pittura*, p. 57.

‡ *Disorso sopra i principi e'l modo d'imparare l'arte del disegno (opere*, Milano, 1811, 8vo, volume iii.)

§ *Introduzione alle tre arti di disegno*, c. 15. *Vita di Michelagnolo Buonarrotti*, p. 129.

|| *Trattato della Pittura*.

¶ *Precetti della Pittura*. c. 3.

\*\* *Elemens de peinture pratique*. P i. c. 1.

†† See especially those engraved after the designs of Palma the younger, of Prospero Fontana, of Annibal Carracci, of Guercino, &c.



leading the student, in the least possible time, to reproduce the effect of the whole and the general aspect of things, and that after several years even employed in this patient study, beginning with the elements of the human figure, one can scarcely hope to reach such a result.

Hence the different systems in which drawing is commenced by the imitation of heads in full relief.

In the boldest of these systems such models are given to the student for imitation from the very first, and without assistance. This is what JACOTOT, the author of what is called the "Universal" system, proposed as an application of his general views toward the simplification of instruction. Experience has proved, as it was easy to foresee, that a head in full relief,—that of the Apollo Belvedere, for example,—proposed as a first model to all beginners, offers them, by its multiplied proportions, complicated by so many mysterious effects of perspective, and light and shade, absolutely insurmountable difficulties; they either lose courage entirely, or else passing on to another work, in spite of the gravest errors, which they are utterly unable to correct, they take up forever the ruinous habit of doing bad work and remaining content with it.

In the system proposed by M. ALEXANDER DUBUIS, more than twenty years ago, a system which has gained considerable support, and which even now has its partisans, the first model proposed for imitation is still a head in full relief, but it is a head simplified.

By this means M. DUBUIS has hoped to preserve the advantages which JACOTOT promised himself by his plan, and to get rid of its inconveniences.

Accordingly, M. DUBUIS gives beginners for their first model a bust which presents only very general masses or features; after this bust, another, which offers some additional indications of the head; then a third in which the details are still more numerous and more decided; and lastly, a fourth, which completes the series, and which alone is all but according to nature. These four busts (of which each is, besides, placed in three different positions: the head set straight in the first, raised in the second, but down in the third,) these four busts thus present four successive states of the same figure, from the roughest sketch up to the completion of it; they are the degrees by which the author of the system proposes to conduct the student, from the general indication of the whole to complete representation, comprising all the detail of the parts.

So that, says M. Dubuis, while commencing Drawing by the entire Head, by a whole, as in M. Jacotot's method, and in all the methods by which it has been sought to abridge the study of Drawing, we commence, however, by a simple and easy object, and only pass in succession, as in the ordinary method, though following indeed an inverse path, from the simple to the complex and from the easy to the difficult. Besides, thinks he again, to proceed thus is to proceed in conformity with the great principle, that general effect should command the details, and that, accordingly, every work of art should commence by the general effect of the whole.\*

In truth, if the different parts may be called simple in relation to a quality, and it is in this sense that the limbs are simple in relation to the body, we may from another point of view consider as simple, in relation to an object completely determined, a less determined state or condition of that same object, and one which consequently presents less complexity; and it is in this sense that the rough sketch of a figure, in which as yet the individual features find no place, is more simple than the finished figure. Now this previous and simpler state is often called, elliptically, the whole; elliptically, for it is not the whole with all the parts composing it once realized, and which themselves in reality form a whole; it is the whole without its parts, the general effect abstracted from the details, or, if you please, the general effect comprehending the details in a manner purely virtual and ideal.

But the character of this whole abstracted from its parts is: to be in relation to the real whole of which it is the sketch, still undetermined, indefinite. Hence it follows that, for him who does not know the details which the abstract whole in its general effect comprehends but virtually, this whole has but an undetermined meaning; and an undetermined meaning is not one at all. To give a beginner

\* *De l'enseignement du Dessin sous le point de vue industriel*, par Dupuis (Paris, 1836, 8vo., p. 29)



such a whole is then to propose to him a model which for him is meaningless. Such a model has, consequently, nothing in it proper to teach the imitator of it exactness and precision, and—the habit once engendered at starting of doing nothing save roughly, and then only almost doing it—when the student gradually arrives at details he will be able but roughly and only almost to comprehend and represent them.

Doubtless whatever one desires to do it is the general effect, it is the whole, the whole without the details of the parts, which must first be established; for it is this whole, in which the parts will successively take their proper places, which must first be correct, and the happiest details cannot compensate for errors in it; this is what LEONARDO DA VINCI incessantly advises Artists not to lose sight of.

It is, in fine, a truth with which the Greeks particularly showed themselves profoundly penetrated; for if there is one quality above all by which their works most surpass those of the moderns, it is in the understanding of the general effect. But it is not less true that this general effect of the whole without parts, by which everything to be done must necessarily be commenced, has no meaning, save by relation to the complete whole, of which it is the preparation and first stage. For the artist who indicates it and who knows what he must add to it, this first general effect (*ensemble*) has then a definite sense, and from this it follows inevitably that the sketches of a master, even the most summary, instead of being confined to a generality systematically shapeless, always here and there let out the determinate, precise, and well defined ideas of which they are the design. But those indications themselves, to an inexperienced eye, are but enigmas. The sketch, in fact, has a meaning only for its author, and for those whom experience and science have put into a condition to share his thought, and to anticipate with him its realization. For a beginner it has no meaning, or only a vague and confused one. To propose it to him for imitation at starting is then, once more, to give him for his first lesson to content himself with an ill-defined meaning: it is to make him contract the habit of doing so; it is to deprive him, by such a habit, of the desire, and soon even of the power, to reach as to any object whatever the definite and determined, that is, the reality. From which it is evident, that while in everything it is by a sketch that what is desired to be done must be commenced, it by no means follows, as M. Dubuis has thought, that the first models should be sketches. Far from this, to habituate one's-self from the start to imitate objects systematically undecided and shapeless is to render one's-self incapable of ever understanding the real forms, and therefore of ever being able to make a simple sketch, such at least as those which come from the hand of a master, and in which, little as there may be, or be seen in them, at least what ought to be is already distinguishable.

However, it must be agreed that the models proposed by M. Dubuis do not present that appearance of vagueness, which is in general the character of mere sketches; this arises from their being fashioned out by planes and by angles. The first of these models presents but the great masses thus indicated; the second only differs from the first, and the third from the second, by the planes and angles being more numerous; and even the last, which approaches nearest to the forms of nature, still retains much of this same character. In this above all, these models differ essentially from the works of a master's hand, and they resemble more closely the successive stages by which the workman or stonecutter mechanically nears by little and little the shape of the marble or the model, which the artist has charged him to reproduce.

The object of the constant reflection of the Masters, the end to which they ever look, being, as we have said, the expression of the character or soul of forms, their constant practice has been to indicate it from the very first, even in the lightest and most fugitive sketch, and accordingly, in sketching the figure of a living being, and above all, the human figure, from the very first to make felt the nature of those sinuous curves or *serpentine*s, (as Leonardo and Michael Angelo called them,) which are its peculiar characteristics, and which reveal its spirit. This is what we see in the drawings of Titian, and of Correggio, as well as those of Raffaele, of Leonardo da Vinci, of Fra Bartolommeo, and of Michael Angelo, as well as in the sketches in wax, and in clay, and even in marble, which remain to us of this great artist.



An entirely different manner has begun to reign in certain schools in the 17th and 18th centuries, according as the true sentiment of the spirit of forms became more weak ; it is that which consists in replacing curved lines and surfaces by straight lines and planes ; confined at first to the detail of figures, to the smallest parts composing them, this process has been more and more applied to the larger parts, and finally, in our own time, among many draughtsmen and painters, it has extended itself to every branch of Drawing.

The models proposed by M. Dubuis present a systematic application of this process, one of which beginners who copy from them must necessarily contract the habit.

Now, in the first place, habituated to see everything under one sole aspect, the eye must by little and little become incapable of understanding the infinite variety which nature offers us ; it must become incapable, above all, of understanding, and of representing those subtile and winding forms which are the distinguishing characteristics of human nature, those forms which Michael Angelo compared to the waving motion of a flame. In the second place, the particular effect of this process which consists in expressing every thing, or almost every thing by planes, is to disguise under the precision of surfaces so regular, the actual indetermination of forms, and so to give to the unskillfulness of him who does not know how to distinguish, and to reproduce the true character, a false air of knowledge. Thus the inconveniences of this method are aggravated.

If by adopting the habit of copying simple sketches, such as (once more) the sketches of the Masters, we can express nothing but in the rough, and only half express it even so, if in consequence we do not reach the truth at all, we are in this properly speaking, engaged in the false, and the very indetermination at which we stop short, might warn us that to reach our end, a part of the road remains to be traversed. But if we adopt in addition, a manner of work which gives to every thing we do a semblance of precision and perfect definiteness, we conceal from ourselves our weakness or our ignorance, and we set a bound to our own progress almost impossible to pass over.

M. Dubuis' method was conceived for the purpose of teaching the art of Drawing to the working classes ; to those classes who have need of an elementary knowledge of Drawing, in the exercise of a multitude of professions, more or less mechanical, and who can devote but little time to acquire it ; and it seems sufficiently appropriate for this purpose. If, in fact, it follows from what we have said, that this method can not lead very far, on the other hand, it is undeniable, that in making the student begin by the imitation of simple wholes, it is, perhaps, fitted more rapidly than any other, to put him in a condition to seize the general effects of proportions, and to put the principal masses almost in their proper places ; and if it is not enough for Art, it is enough for what of knowledge of Drawing most trades require.

This method, once more, may then answer sufficiently well for the instruction of the artizans for whom it has been designed, but that is no reason why it should be introduced, as some have desired it should, from these popular schools where it is said to have done good service, into the schools of a superior class, and above all into the *Lycées* [Colleges, or Collegiate Schools.]

However, if it be a method by which we can indeed acquire more rapidly than by another, a certain knowledge of Drawing, however limited, perhaps we should be tempted to believe, that it ought to be adopted in preference by all our schools, except those especially destined for the formation of Artists. Every where, some will perhaps say, it is for the greatest number, and especially for them, that we should chiefly be concerned ; now the greatest number has need of knowledge of Drawing only of a very elementary kind, so far as it is required, not for the practice of the Art, but for the different industrial pursuits with which Drawing has something to do. What is of the greatest importance is this, that those very persons who can devote but few years to general study, and to that of Drawing in particular, should be able in those few years to learn as much of it as is necessary for representing with some accuracy the situations and dimensions of things ; and if it be a method by whose employment such a result can be reached, even if it cannot serve, nay, even if to a certain point it interposes an obstacle to further progress, this imperfect but expeditious method must still be preferred.

We cannot share in such a view.



Even admitting what is far from being incontestable, that for the practice of the different branches of Industry, there is never any need of drawing with the same precision, and the same delicacy, with which artists must know how to work, it is still one of the first interests of industry, and consequently of the great number who are engaged in it, that art should not decline in the hands of those at least who practice Art. It is from Art that all the branches of Industry which have any relations with it, receive their inspirations. It is Art which supplies them with the types which they multiply, in accommodating them to our different wants, or to our different fancies. All are constantly occupied in appropriating to every thing that surrounds us, the forms with which the imagination is captivated, and of which that Art which reigns at each epoch is the source; all profit by the power of seduction which Art exercises, and by the favor which attaches itself to every thing that bears its mark.

When a great master appears, and comes to show all things under an aspect till then unknown, for such is the privilege of genius, all that is subject to the power of man, must put on those proportions, those new harmonies which he is come to reveal. Thus to spread and to apply its thought in every form, the ancient arts are transformed and regenerated, and new arts take birth. And to this immense work come together, yet from afar off, to furnish its materials, even the very branches of industry, which seem the most foreign to the Art of Drawing. Who can say what even the most mechanical professions owe to the genius of a Raffaele; not only the art of Marc Antonio, not alone that of the potters of Faenza, of Gubbio, of Pesoro, and of Urbino, not alone the fabrics of the tapestry works of Flanders, and the enamels of Limoges, which have reproduced his creations under so many forms, but all the industries of his age, and of the ages which followed his; how many men have lived on the fruits of his thoughts, and of what riches of every kind it has been the source? Who can calculate what for three thousand years, one half the universe owes to that Greek Art from which even still, though modified by so many different influences, not only the forms of all our public works, but those even of our vessels and commonest utensils are derived?

And as for the industry of France in particular, if it be by so many titles in the first rank among the industries of Europe, to what is this due, if not to this, that the first rank already for a long time belongs to our painters and our sculptors, and that in Art, no more than in Literature, no nation can dispute it with her?

What worse service then would it be possible to render to the greater number in every country, but above all in ours of France, than to put every where in force methods of instruction calculated to set bounds, even to the measure of mediocrity, to the development of talent, and by an ignorant zeal for the crowd, to arrest the flight of those men of rare genius, (*gènies d'élite*) which it ever conceals in its bosom, and whom Providence destined to be its benefactors?

Will it be said, that rare Genius knows how to burst its way, whatever difficulty it encounters, and that it is useless to take special care of it? Examples abound in history, and in the history of art in particular, of men of genius happily endowed, whose career has been falsified, and destiny destroyed by a bad education.

In the second place, and supposing even that one should not occupy one's-self with this small number, with this *élite* which will practice Art with success, and spread its benefits over the crowd, nor even with those already more numerous, to whom it would be useful, in the career which they have to pass through, to possess the knowledge of Drawing to a somewhat higher degree, it is certainly important that among the greatest possible number taste should be healthy and good. And so, if the state of Art, and consequently of all the industries which depend on Art, depends upon the genius and education of artists, it depends also, in very great part, on the judgment of the public, which, by its approbation or disapprobation, may sustain the artists in such and such a course, or turn them from it. Now, as PAUL VERONESE said, "those alone can form a good judgment upon matters of Art, who have been well instructed in Art." Accordingly, since taste is the just appreciation of the beautiful, since between the beautiful, the true, and the good, there is a close connection, and so to speak, an intimate solidarity, what interest is more general, than that to direct instruction in Drawing,



in such a manner as to give as much as possible to all those who take part in it, a just and delicate taste, a sure discernment of beauty? If that is true for all the schools, for how much stronger a reason is it not true for the schools of secondary education, and where those are educated, who by their lights, as well as by the place which they will occupy in our society, are destined to exert the most powerful influence upon the spirit of their time?

For these different reasons, we cannot recommend the establishment in our *Lycées* of any of those expeditious methods which lead, however ingenious they may be, but to an inexact and erroneous appreciation of forms, and their character. The only method which we can propose for the approbation of the Minister, must be that method which will lead, though at the price of a little more time and trouble, to the end of Instruction in Drawing, such as we have been able to define it, after the great Masters of Art; the possession of that good judgment of the eye, by which men appreciate proportions correctly, and understand their spirit and beauty.

We have seen that the human head is an object too complex to serve for a first model for the student, that in seeking from the start to imitate its forms, the beginner can but contract a habit of error; we have seen also, that to propose for a first model, a whole in an abstract form, and without parts, is again to teach, though in another fashion, but error and confusion.

Hence, we are of necessity brought back to the method which has almost always prevailed, and which confirms the authority of all the masters of Art, that which only allows the whole to be studied, after a profound study of its parts.

“The sight,” says LEONARDO DA VINCI, “has an action of the quickest, and embraces in one moment an infinity of forms, nevertheless, it only comprehends one thing at a time. Let us suppose, reader, that you bestow one rapid glance on all this written page, you will judge in an instant, that it is full of different letters; but you will not know in so short a space of time, what letters they are, nor what they mean; you will be obliged then to go over them word by word, line by line, in order to comprehend those letters. Or again, if you wish to reach the top of a building, you must mount up step by step; without which it is impossible for you to reach the top. And so it is, I say to you, that Nature regards this Art of Drawing. If you wish to have the true knowledge of the forms of things, you will commence by their parts, and you will not pass on to the second, before you have the first well in your memory and in your practice. And if you do otherwise, you will lose your time, or at least, you will prolong your study. I repeat to you once again, learn accuracy before rapidity.”

But it is said, on the other hand, if we cannot begin with the Whole, why not descend to details still smaller than those by which one generally commences, why not descend to the fingers, to the nails themselves.

It is, because, in recommending not to begin with the entire of a visible natural object, nor even by a whole, such as the human head, too complicated still, although this too is but a fragment of a whole, nevertheless for an inexperienced eye, in order to satisfy the two principles equally certain as they are that we can not commence with a very complicated whole, and that only a whole can make itself understood, reason requires that we should commence with parts, which, though parts, yet form wholes in a sense in themselves, and are in consequence intelligible objects. We will stop then, as men have always done, at those fragments which have to a certain extent a special destination, a special character, a distinct individuality, such are the eye, the ear, the mouth, the head, &c. Sufficiently simple not to surpass the comprehension of a beginner, every such part is already a whole in itself, in right of this quality, and like a whole, each such part may be understood by itself alone. As parts of a Whole more complicated, they cannot, it is true, be understood without that whole. It is then by arriving at that Whole in which they act one with another, and where they harmonize together, that—after having studied each part separately—they can all be understood.

After having taken as a base of operations, as we do in every science, that which is less intelligible in itself but more accessible, it is in the last place, according to the order which befits our weakness, and which is recommended by



wisdom, that we raise ourselves to the culminating point of complete science, which is like an elevated pinnacle, whence we can embrace all, and understand all.

Lastly, to leave from the very start, only so much obscurity around the meaning of the several parts of the human figure, as the time is not yet come to clear away, we should not neglect to make beginners see from the first in a general way, the relations they bear to the whole, and the position which belongs to them. It is also thus, that in every science a general and preliminary exposition precedes instruction in detail, and prepares the way for that last and philosophical exposition, in which the details reunited and arranged in the whole, will receive their last and full explanation.

Such is then the order which theory prescribes to the practical study of Drawing. But the determination of this order, is this the only share which theory should have in instruction? And accordingly, the order of practical study once determined, is it enough for the learning of the elements of Drawing, that this study should consist in commencing with the imitation of the parts of the head, and finishing with that of the entire figure?

[After having demonstrated, (continues the Editor of the *Bulletin*,) by the reasoning and by the authority of Leonardo da Vinci, of Michael Angelo, of the artists of antiquity, &c., the necessity of the study of the anatomy of the bones and muscles, and that of the proportions, M. F. RAVAISSON proceeds as follows:—]

In fine we have seen above that Drawing is properly speaking the representation of the proportions of things as they appear to the eye. We have also seen, that if we can hardly well judge of the reality by the visible appearance, which is for us its sign, we can hardly see the appearance either as it is. Hence, constant difficulties, as well when we invent, to give to the things we imagine the forms they ought to have, as when we imitate, to judge accurately of the appearances of things and to reproduce them faithfully. Hence an uncertainty from which we can scarcely escape without many errors.

Now the relation between visible appearances and actual proportions, for any point of view and any distance, is regulated by geometrical laws; by these laws, which are those of perspective, we can with certainty anticipate experience, and without error, destroy the appearance of the reality, or the reality of the appearance. Who then can doubt that the knowledge of it would be most useful to assure the judgment of the eye, and to protect it from error? And so, at the era, at which the art of Drawing among the moderns has attained the highest point of perfection, we see perspective held in honor.

After Brunelleschi, Paolo, Uello, Lorenzo Ghiberti, who were the first to understand well its rules; after Pietro della Francesca, who was, it is said, the first to give the theory of it, the masters whose works adorn the middle and second half of the 15th century, Massaccio, Filippino Lippi, Pisanello, Signorelli, the precursor of Michael Angelo, Melazzo de Forli, whose frescoes probably taught Corregio the art of backgrounds, (*sotto in su*) Vincenzo Foppa, the two Bellini, Mantegna, Ghirlandajo, Perugino, showed themselves consummate in the new science; Leonardo da Vinci made it the subject of a book, now lost, which became the source of the principal works in which it was treated in the 16th century; Raffaello, in fine, to whom Perugino had taught it, knew it so well as to give lessons to the great Florentine painter, Fra Bartolommeo. And we cannot doubt, that the knowledge and habitual practice of perspective, effectually contributed to give to the art of Drawing, among the painters of the golden age of Art, much of that exquisite accuracy, and accordingly, that finished elegance, from which men subsequently receded more and more, according as counting more for the concealment of mistakes on the play of light and shade, and the effect of aerial perspective, men trusted more and more to the unassisted judgment of the eye.

It is not that when we learn to draw, we must frequently put in practice the rules of perspective, to find the place and dimensions of outlines and shadows. We have already said, that to construct forms by geometrical rule, is no longer to draw, but to trace them, and consequently it can not teach us to draw. But at the same time that it furnishes us with an exact means of geometrical construction and verification, the knowledge of the principles of perspective, united to the habit of applying them, must necessarily, in making us attentive to the perspec-



tive diminutions of proportions, and the laws which they follow, lead us to observe them better, to appreciate them, and to represent them more justly.

Now if the knowledge of perspective serves to make us judge well of all visible forms, of those of the bones and muscles, as well as those of the exterior surface, does it not follow, that it is with perspective that instruction in Drawing ought to commence? Practice should be founded on good theory, of which perspective is the entrance and the guide.

Will it be objected that it prolongs too much the teaching of Drawing, to join with it that of perspective, as well as the structure and proportions of the human figure? Very far from this, these are ideas which at the same time that they must throw light on practice, and so render its progress more rapid as well as more sure, may be acquired in a time relatively very short. These principles, says LEONARDO DA VINCI, who continually recommends to begin with the study of the scientific principles of Art, these principles are but a little thing near Art itself.

To learn in the first place, perspective; in the second place, the structure of man and his proportions; in the third place, only to draw the human figure; first, the several parts, and then the whole; such then is the order prescribed by Leonardo da Vinci for the study of Drawing, and which has not ceased to be the order most profitable to follow.

This does not, however, prevent the teaching of the scientific principles of Art from being usefully preceded by a certain number of lessons, consecrated to purely practical exercises, exercises which may consist of the imitation of simple figures, such as those of regular solids, of some parts of vegetables, &c. In these first essays, we would accustom ourselves to draw the outlines, to indicate the shadows; we would accustom ourselves, above all, to observe proportions and forms, and the very difficulties themselves which we should experience in judging of them accurately, and reproducing them well, would dispose us to recognize the necessity, and to comprehend the use of those principles, whose methodical application will serve in the regular course of instruction, to resolve successively the various problems of Drawing. These different exercises would thus form a sort of preparation for the regular course of studies, which would commence with perspective.

In our schools, (*lycées*) where for every reason the instruction must be but very elementary, the study of perspective will be necessarily confined to general principles, and to the applications most useful for the practice of Drawing. Care should be taken above all to explain how this science, which is at present scarcely applied save to the foreshortening of regular forms, which can be geometrically drawn such as those of a building, may be applied alike to every kind of forms, and particularly to the human figure.

The study of measures (and proportions) should extend only to those which it is most important to know, and which are the most constant; and the master should apply himself to explain by examples chiefly borrowed from the *chef-d'œuvre* of antique art, how the infinite variety of individual forms reconciles itself with the general rule, which is the law of species. The study of the anatomical structure also should be limited to what is most necessary to know, and what may be learned from casts, prints, or photographs, upon the situation and functions of the muscles and bones.

But, on the other hand, it would not be enough for the scientific principles of Art, that some lessons more or less abstract, should precede the practice. In Art practice is the end, theory is one of the means of reaching it. From the start, theory ought then to be accommodated to practical use, and practice ought to the end be enlightened by theory, and incessantly take counsel of it.

Consequently, when the principles of perspective are explained to the Students in our schools, care should be taken to make them sensibly understand those principles, by exhibiting to them, and causing them to make for themselves immediate applications to objects analogous to those which a little later they will have to draw. And on the other hand during the course of practical study, and throughout its whole continuance, no occasion should be neglected to make them see how the problems offered to the eye by the foreshortenings, implied by relief, in every object of nature, all range themselves under the general laws of perspective, and how it leads to resolve them. It is thus that throughout all instruc-



tion in Drawing, the maxim is verified, that "Perspective is the bridle and helm of painting."

In the same manner, in giving the necessary instructions upon the anatomical structure of Man, as applied to the Art of Drawing, and upon his chief proportions, care should be taken to make it clear from the very first by examples of its practical usefulness. Afterwards, as fast and according as the student is made to draw the different parts of the human figure, or even entire figures in different movements and attitudes, he should be made to study it anew, more deeply, and in greater detail, and as well structure as proportions. For this purpose no mode perhaps is better than that proposed by Alessandro Allori, and which was but the application to Instruction in Drawing of the ordinary manner of proceeding adopted by Michael Angelo; a mode which consists of either before making the student draw each part of the body as it is in outward form, to make him first draw the bone which it includes, and then the muscles or cartilages which are covered by the skin; or at least occasionally, to place by the side of the models after which the superficial figures of the objects are to be reproduced, the representation of their anatomical structure, a representation, which in part explains their appearances, and which thus leads the student, as in other respects the knowledge of the laws of perspective leads him, to understand them better, and therefore to draw them better.

In anticipating experience, according to an expression we have borrowed from Leibnitz, science reduces the probabilities of error, which experience always allows, and lets none of them exist, as has been said also of wisdom in respect of chance, save what cannot be taken away. This is also what the previous study of the Parts does in regard to the study of the Whole. The parts once well known in their constituent elements, in the chief varieties of form and under the different aspects which they can present, when we come to the whole we half know it already, and familiarized with elements analogous to those of which it is composed we understand it better and represent it better. It is, therefore, as we have said, that the parts must be studied before the whole; it is, therefore, also that there is no use in studying them unless we study them profoundly, so as to know them well, and that, consequently, "we must not pass from a first to a second unless we are in possession of the first."

From this, several practical consequences follow. In the first place the parts of the human figure ought to be, in general, as well in models as in the copies which the students are caused to make, of equal dimensions with nature, or at least very nearly so; for in objects of small size one is more exposed to miss seeing all, and for the same reason, "in little things one does not see his own faults as he does in greater."—Once master of the detail of the parts, we may, on the other hand, when we come to draw entire figures, give them without any inconvenience, smaller dimensions. In drawing such figures, in order that we may keep the different parts of the copy we are making in proportion one with another, we must embrace the whole of it at a single glance; and the custom has very reasonably grown to be not to give the drawing of the entire figure dimensions greater than those of an ordinary sheet of drawing paper. There is something more; these dimensions are those ordinarily given to the models themselves; now, since we learn to draw only by the judgment which we apply to the relations of dimensions or Proportions, and as, consequently, it is important that beginners should not be able to contract the habit of taking measures on the model to dispense with that judgment, it is a useful thing to practice them in giving to their drawings, representing entire figures, dimensions different from those of the models from which they copy. It will then be proper, if the models in general are only of the size of an entire sheet of paper, to make copies from them occasionally of a smaller size. But for this reason, that in little things one cannot well judge of his own faults, and that the student may not become accustomed to content himself with inexact imitations; the dimensions of drawings of entire figures ought not, in any case, to sink lower than those of a half sheet of drawing paper.

In the second place, objects are only well distinguished by their lights and shades, which render sensible their relief. If the line which marks the extreme limits be sufficient to represent the figure on a smaller scale, and to secure its recognition, it is but by the lights and shades presented by its surface that we can



understand exactly and completely its proportions, its character, and its special beauty. In order to fulfill the precept according to which, in all the course of his studies, the student must not pass from one object to another until he understands the first well, it is therefore necessary that in respect of every object he draws, from the most simple parts to the most complicated whole, he should not confine himself to a line, nor even to a rough indication of the model, but he must apply himself to reproduce, and to reproduce exactly, the lights and shades.

"If you wish, oh draughtsman," says Leonardo da Vinci, "to make a good and useful study, judge well among the lights which are those, and in what number, which possess the first degree of brightness, and so among the shades which are those which are darker than the others, and in what manner they mingle together, and compare these always one with another; and lastly, let your shades and lights be joined without lines or points, and mix with each other like smoke. And when you shall have brought your hand and your judgment to this amount of exactness, the practice of drawing will come to you so fast that you will not even be conscious of it."

To express the exact character of the shadows with the same pencil which serves to mark the outline, to render it with softness, and, according to the Italian expression *sfumato*, by parallel, or crossed shading, great labor is required, which occupies much time. With a stump both the shadows, and, the passage of the shadows into the lights, can be imitated both more easily and more quickly. It would seem then, and it has been proposed, to prescribe the use of the stump rather than that of the pencil for the imitation of the shadows.

The Commission is nevertheless of opinion that for teaching, and in order to form the eye to judge well of forms and their character, the pencil is preferable to the stump. The pencil represents shadows by simple lines. These lines according to the direction in which they are traced, may contradict the forms whose relief they should serve to express, or, on the contrary, by conforming themselves to these, may assist, by their very direction, in making them better understood. To put in the shadows with the pencil, the general effect and the details of the forms must be then observed every instant, as well as the changes which they undergo by foreshortening. Each line, each shading becomes thus a teacher of the character of things, of their anatomical construction, and of their perspective. This is what we are shown by the drawings of the best painters, and the prints of the best engravers, with whom to put in the shades is never any thing else than to draw. Moreover, we have not stumps always by us; and on the other hand we have always at hand a pencil, or a pen, or something which can take its place and perform the same office. It is important, on principle, to learn to make use above all things of those means which are least likely to fail us, and to know how, in short, to paint the shadows with the same point which serves to make the outline.

If then the use of the stump may occasionally be permitted, if it be even useful to learn in good time to manage it, were it but to make one independent of every process and special mode of working, still the habitual instrument, and especially at the start, should be the pencil.

From all that precedes, it follows that the object we should propose to ourselves in indicating the shadows is, not so much to please the ignorant or ill-taught eye, by the regularity of the work, as to express in a manner as perfect as possible the figure and character of the objects drawn. In this manner by devoting to the study of the model and to the light and shade all the necessary time, the greatest part of the course will not be taken up, as often happens, in the minute imitation of the works of engravers. Besides, once that we have become, by sufficient practice, able to express the half tints completely, in the absence of which the lights and shadows do not possess their true character, but which form the most difficult part of the study of the model, and that which requires the longest application, we can, without omitting them, spare ourselves, nevertheless, the time necessary to represent them well with the pencil. For this it will be sufficient to draw on a ground by whose tint they are supplied. This is what was done in the best times of Art, by using for drawing paper, paper slightly colored, upon which the shadows were indicated in black, and the brighter lights in white. And according to Leonardo da Vinci, who managed the pencil as well as the pen



with astonishing dexterity, this is in fact, the best method to draw from models in relief.

We have seen that it is by the separate parts of the human figure, and not by the whole, that a beginning should be made, and for this reason, that in all things the path which ought to be chosen is that which leads from the simple to the complicated. For the same reason, the first models should not be reliefs, (round figures,) but imitations of relief in the flat. "Begin," says Leonardo da Vinci, "by copying the drawings of good masters, you may afterwards copy from figures in relief." Drawings, indeed, or prints, or even photographs, do not offer effects of perspective so deceptive or so enigmatical as those given by reliefs, or round figures; the lights and shadows in them have not the same magic, and allow of being more easily understood. And in fine, the very labor by which the author of the drawing or print has imitated the relief or round, is, for him who seeks to imitate it in his turn, a necessary imitation in the different works of Art. Figures in relief (in the round) should not then be drawn until the student is in a condition to reproduce drawings and prints with sufficient accuracy.

Those drawings or prints, whether they represent the parts of the human figure or entire figures, ought to be the faithful reproduction of types borrowed from the best masters of all times. Photography, too, may come to the assistance of the pencil or the graver, not only in the multiplication of drawings of good authors, or of rare prints, but also even in affording direct reproductions of masterpieces of painting or of sculpture, or representations of nature.

As to models in relief, (figures in the round,) it is among the *chefs d'œuvre* of ancient sculpture that they should almost all be chosen.

Under the influence of systems in error both as to the object and the aim of Art, a custom has become established of selecting almost exclusively, as models for instruction in drawing, among the specimens which remain to us of the ancient statuary, figures of the class called ideal figures, in which it is believed may be found the representation of human nature in its most abstract generality, figures possessing the least individuality possible; without perceiving that of these figures, those which are more remarkable for the regularity of their forms than for their truth are, for their most part, copies or imitations in which the particular character presented by the originals has more or less disappeared, and their general proportions only remain,—it is to such second-hand works that the preference is often given. And from this it arises that in learning to draw, one learns to regard only a conventional type of forms and movements, and one becomes incapable of comprehending the infinitely varied beauties of nature.

In consequence of the discovery made at the beginning of this century of a great number of original works of the finest period of Greek statuary, a discovery which vividly affected the imagination of men: in consequence also of the reaction in an opposite direction which was naturally produced by the insipidity of so many works inspired by the worship of a false ideal: the opinions which used to govern the domain of art, and that of criticism, have become modified. Individuality, Truth, Life, are restored to their rights; and it may even be doubted whether, after, having so long inclined towards one of the two poles between which modern art has almost always oscillated, we have not now thrown ourselves too far in the direction of the other.

However this may be, elementary instruction has continued almost everywhere to follow the same errors as before. To cut this short it has been proposed in the commission, to allow no models in future to be taken, among so many works of ancient sculpture which remain to us, but those which carry to the highest pitch the character of individuality and truth: that is, the Portraits.

The Commission has come to the conclusion, that if this proposition should not be admitted because it is exclusive in its turn, that if, on the contrary, we can not too soon place before the eyes of youth the *chefs d'œuvre* in which the human form, the most perfect of all forms in nature, has been represented in its highest perfection, and thus penetrate their still young imaginations with the principles and essence of the most excellent beauty, nevertheless, in order to teach them to understand and love nature in her inexhaustible variety, it is well to give them also a certain number of masterpieces of another kind to study, so as to reproduce, from the very first, those masterpieces in which Art has expressed with the greatest *naïveté* the beauties proper to individual types the most special and peculiar, without seeking to reduce them to a higher Beauty.



Moreover, those very figures should be selected which can, in a certain sense, be properly called ideal: the figures of gods, of goddesses, of heroes, of heroines, among the works of the best ages, in which the masters, penetrated with Nature and full of her spirit, have always known how to unite individuality and truth with beauty in their works. Such are the works which remain to us of Phidias or his cotemporaries, and of the great sculptors who followed immediately after him.

“The painter,” says Leonardo da Vinci, and the same may be said of the draughtsman, “should study by rule, and should let nothing escape being treasured in his memory.” And it is therefore that he recommends the student, after having made a copy of a model as exact as he is capable of making one, to practice himself in reproducing it from memory. By this exercise, in truth, not only is the memory strengthened, without which there is neither art nor science, but also the attention, which is nothing else than the intellect itself strained and applied by the will; and in fine, those types which the student has learned to comprehend by attentive comparison of their proportions, preserved and constantly present in the imagination, become permanent subjects of new reflections, comparisons, and instruction.

To drawing after models should then be united as much as possible this practice of drawing from memory, which, long neglected, has been introduced successfully as we have already had occasion to say, several years ago, in the teaching of the special school of drawing, (*école spéciale de dessin.*) But, as we have also remarked, in order that this practice should not have those inconveniences which attend on the habit of working without a model (*travailler de tête,*) and that it may not keep one away from the observation and simple (*naïve*) imitation of nature, it is important, according to the express recommendation of Leonardo da Vinci that a faithful tracing should constantly serve to verify and correct the inaccuracies of the drawing from memory; it is upon this condition that such a practice may be used, without danger, to fix in the mind the results of the imitation of models.

In making the student study and reproduce the different models, the professor should teach him to attend to the expression, above all, of their essential character, that character which is from the very first visible in the whole at one view, and which is found to be the same in the smallest details; he should teach him therefore, from the first, to express the general character in the whole, he should teach him in the next place never to lose this point of view, but to pursue his researches even to the details of the very smallest parts. He should apply himself thus to make his pupils understand how in the *chefs d'œuvre* of art, just as in the works of nature, the different parts are among themselves analogous in their movements, their proportions, and their forms; how, accordingly, while they have each their own peculiar nature and spirit, they nevertheless express by their correspondence and mutual agreement, the indivisible spirit which is the soul and principle of the whole; how, in them, in short, variety is thus made subject to the law of unity, which forms out of it an order and harmony.

He will apply himself to make clear how it is that in those masterpieces in which especially reign those proportions to which, with Leonardo da Vinci, we may give the name of Divine, with still greater variety is united a more perfect unity: how these two opposite elements of harmony rising at once, so to speak, to a higher power, and the unity of the idea becoming more vivid still by the very contrast of the diversity which it subdues under its law, there results that superior harmony which constitutes beauty; how, in short, in all true beauty, even when the character of the movements and forms is rather grace than strength, or elegance rather than majesty, nevertheless, by the predominance of the whole over the parts, of the unity over the variety of the subject, order partakes of grandeur, and with the beautiful, properly so called, is mingled more or less of what is called the sublime.

By these means he will teach his pupils by little and little to recognize in true beauty the image of that Spirit which is its divine and mysterious principle, and he will render them capable by degrees, of comprehending that thought of a great master, painter, and philosopher, that the Beautiful, for all that it manifests itself in bodies, is by nature Incorporeal.

But to teach men to judge accurately of the spirit of forms and of beauty,



which is the highest object of instruction in Drawing, the study which can be made of models copied and reproduced from memory is not enough. Their number is necessarily too much restricted. "It is not enough to draw" says Leonardo da Vinci, "we must still see and compare the works of different masters."

The pupils in our schools (*lycées*) not being able to go to seek here and there the various works of art dispersed in so many places, nor even to visit, except very rarely, the Galleries where they are collected in great numbers, shall they then be deprived of this necessary complement of education? This advantage would be secured to them to a certain extent if each school were made, as far as possible, a Gallery; and this might be accomplished without much expense, by placing not only in the hall of instruction, but also in the parlor, in the refectory, on the staircases, beneath the vestibules, in the several school-rooms, every where in which the arrangement of the place would allow of it, and in such a manner as to harmonize with that arrangement, reproductions, by casts, engravings, or photography, of the *chefs d'œuvre*, of every species of ancient and modern Art. Their powerful and favorable influence would thus be every where and always exerted over the minds of youth; fed by the poetry of Homer and Virgil, of Corneille and Racine, it would also feed itself, every moment of the day, and almost unconsciously, upon that of Phidias and Raffaele, of Jean Goujon and Poussia.

To this programme of studies the Commission thinks it right to propose to the Minister to add one branch of instruction which hitherto has not found a place in the teaching of Drawing as it has been conducted in our schools, (*lycées*), and which has nowhere perhaps been regularly organized: it is that of drawing specially applied to those forms which are altogether the creation of Art, and which in opposition to those of natural objects, we may call *artificial* forms. These forms are those of the different objects which Art invents for the various wants of life, or for the satisfaction of that which Michael Angelo called the insatiable fancy of man: buildings, furniture, vessels, utensils, ornaments of all sorts.

The beings which Nature creates are in their substance and their forms that which is required for the end which they have to fulfill; and at the same time they compose harmonies, either by their figures or by their colors, which satisfy one superior and universal end which is Beauty. The objects which Man creates for his use are also determined, both in their substance and their forms, by the very nature of the wants they have to serve. But, like nature, man also pursues at the same time a higher end. Among all substances, among all forms, he chooses as much as possible for his creations those which best satisfy the conditions of Beauty. This is not all: to these forms he adds others which may serve, either better to express the idea from which the first proceed, or else to raise their beauty; these accessories, by means of which objects tell what they mean, in some sort, with more clearness, force, and grace, and in a more elevated style—these accessories which form the poetic character of the principal forms, and which accompany while adorning them, as a musical harmony accompanies and emphasizes the theme of the melody—these are the *ornaments* of the creations of Man. In the first place, the *forms* which Art creates for the objects necessary to the different uses of life; in the second place, the *ornaments* of which they are susceptible; such should be the double object of this new branch of instruction, which the commission think it right to propose for institution.

Since the time which can be devoted in the schools (*lycées*) to the study of Art would not by any means suffice to complete it in all its parts, nor even in any one of them, it is evident that, instead of running over them all, so as to learn nothing, or very little, the best thing is, generally speaking, to apply ourselves to push as far as possible the study of that which is the most difficult as well as the most important, and which one can not know without being capable of learning all the rest in a little time, that is to say, the study of the human figure. For whoever is able to represent the human figure well in its proportions, its character, and its beauty, will learn without difficulty, and in but a little time, to represent as well the proportions, character and beauty of animals, landscape and flowers, &c.; while the converse of the proposition is by no means true. From hence it would seem that neither can there be found a place in the schools (*lycées*) for teaching the drawing of those forms which we have just called Artificial forms. These forms, in truth, composed of the same elements as those of natural objects,



do not surpass—for the most part do not even equal them in complications and difficulties. So a man may form a good judgment of the proportions of a candelabrum or vase, who could not judge as well of those of a great part of the beings which Nature has created. A man, on the other hand, who knows how to see animals and plants accurately, and therefore to draw them well, will be able to appreciate, and therefore to draw as it ought to be drawn, a vase, a candelabrum, or a volute. How much better still he who is able to understand and to trace out the cunning lines of the human figure!

But although in the drawing of the human figure the universal principles of the drawing of other kinds of forms is included, nevertheless, each of these kinds has again its peculiar principles. Hence it follows, that in order to draw well the forms they include, and consequently to form a good judgment of their proportions, of their character, and of the particular beauty of which they are susceptible, we must unite with the study of the drawing of the human figure, certain other special studies. If this is true of the forms of natural objects, perhaps it is still more true of those of which the imagination of man is the source. The forms of nature, in truth, being more or less analogous to our own, answer, by a secret harmony, to the intimate constitution of our souls, and hence it comes that even those who possess not the slightest trace of art, judge tolerably well of the beauty of such forms, whether in nature itself, or in the works of art which represent it. As to those, on the other hand, which are the creations of art, the cultivation of taste alone, by seeing and studying masterpieces, makes us capable of judging of them.

Again, for the very reason that these forms are those of objects which serve the ordinary purposes of life, and which our wants, or the variations of fancy, invite us perpetually to alter and renew, we have to exercise our judgment upon them continually; and this is another reason why it is desirable that studies of a special nature should put us in a condition to bring an enlightened judgment to the task.

To this consideration is to be added another, drawn from the interest of these arts themselves, with which, in our country of France above all, so many other interests are connected. If the destiny of Art, in general, depends in great part on the opinion, more or less enlightened, of the public, this is especially true of those arts which are closely connected with Industry, and which can not dispense with the connection. Separated from the public by intervening circumstances, more or less numerous, scarcely known to it, even the artist who, in these arts which are reputed as secondary, displays the rarest ability, produces no impression by the authority of his name, and exercises but a weak influence on the judgment of the majority of men. If, besides, in order to judge of pictures and statues, we are well content to defer to a certain extent to those skilled in the knowledge and practice of painting and sculpture, and who, in consequence, are necessarily the best judges of such works, still the same thing is not true in the case of those familiar articles by which we are surrounded, and of which we are making some use every moment, and every one willingly thinks himself capable of forming a judgment as well as any body else.

Lastly, let us add that if of all the branches of Art, the Drawing of such objects as industry appropriates to the various uses of life is not the most elevated, nor that consequently, which can most contribute to the education of the soul and the mind, it is that which, on the other hand, in addition to the advantage of enabling us to exercise a judgment upon those things of which we have the most frequent need, unites this advantage too, (which is a necessary consequence of the former,)—that of finding immediate employment in the greater number of industrial professions and trades.

In giving, then, the first and highest place in the study of the elements of art to the Drawing of the Human Figure, which is its highest branch, it seems that there are sufficient reasons to make room also for that branch of art which in some sort occupies the other extremity of the scale, and whose direct applications are by much the most numerous as well as, materially at least, the most useful.

Since those forms which are the creations of the imagination divide themselves naturally, as we have said, into great classes: namely, the figures themselves of buildings, furniture, utensils, &c., and the ornaments with which these different



objects may be clothed, the teaching of the Drawing of artificial forms should also be divided into two portions, corresponding with these two classes of objects. During the first portion of this teaching, the student should be made to study at first select profiles of some of the principal features of which Architectural Buildings are composed, the Vases, Brackets, Vasques, Balustrades, Candelabra, &c., adding sometimes the study of the ground plans of architectural works to that of their profiles. In directing the study of these objects, as in that of Man, the master should apply himself to make it clear how the proportions of the different parts depend on one another, and vary one with another; how in this agreement and connection, which give to every work of art its special beauty, as well as its definite character and expression, the thought shines out, the spirit which produced such forms; how from the harmonious concert of those proportions which Leonardo da Vinci called "divine," results at last the perfection of Beauty.

To this teaching should be joined the exhibition, by a sufficient number of examples, of the several modifications which the various forms must undergo, and the particular characters or expressions which they must assume, according to the difference of substances, following the different nature of marble, of stone, of granite, of wood, of ivory, of iron, of bronze, of the precious metals, &c.

In directing the special study of ornamentation, the professor should make known both the principal types which art has created, and those which it most commonly borrows, whether from the animal or vegetable kingdom; he should, above all, explain how it modifies the elements supplied by nature, and transforms them so as to please the fancy of men.

For every branch of this course of study, the models should in general be borrowed from Greek Art, which, in this department as in all the others, knew how to unite with the most perfect agreement of the forms, with the destination of the objects and their material, the greatest originality of character, the highest style, and the most surpassing beauty. Other models may, however, be added, borrowed from Roman and Oriental art, as well as from that of the Middle Ages, and of the *Renaissance*, which, though they do not reach the same degree of supreme perfection, have, nevertheless, produced a crowd of masterpieces in this department.

The exercise of reproduction from memory, which would fasten in the imagination the most finished types, should be applied to the drawing of artificial forms and their ornaments, as well as to that of the human figure, and will produce the same result.

Perhaps to these studies, should be added some practical lessons on the employment of color in ornamentation, lessons which would initiate the student to a certain extent in the knowledge of the relations and harmonies of tones in color.

To conclude, as in the case of figure drawing, besides the models of artificial forms, which may be made during the progress of the course, other *chefs d'œuvre* of art, placed in every direction throughout the schools (*lycées*) under the eyes of youth, would succeed in penetrating them with the spirit which produced them, with that universal spirit from which equally proceed that heroic *contours* of the marbles of the Parthenon, and the profile of the least of the earthen vases hidden in the sepulchres of Athens or of Vulci.

[The Commission proceeds to point out the proper distribution of all these studies, among the classes in the *lycées*, the schools of general education in France, and conclude with recommending that Masters in Drawing, shall undergo a special examination, and rank hereafter as Professors, and that the proficiency of the pupils shall be tested by frequent inspection confided to men possessed of special knowledge on the subject, who shall report periodically to the Minister the results of their observation.

Upon this admirable report the Minister of Public Instruction has promulgated a Decree embodying its several suggestions as part of the national system.]



## CONSERVATOIRE IMPERIAL DE MUSIQUE ET DE DECLAMATION.

THE *Imperial Conservatory of Music*, at Paris, was founded by Louis XVI, in 1784, and was then called *Ecole de chant*. It was reorganized in 1795, at which time it received its present appellation. Although originally intended to train actors and singers for the imperial theatres and operas, it has become a good normal school of professors of music and vocal culture generally.

Pupils are admitted only after a competitive examination. It is free, and its privileges are enjoyed by about six hundred pupils annually. Connected with it are a library of music and books on the art, and a gallery of musical instruments, which are accessible to the public.

It is governed by a director, an administrator, and two committees, the committee of musical instruction numbering fifteen, and that of dramatic studies numbering fourteen.

Besides these there are attached to the school, a secretary, two librarians, one curator of the museum, an officer at the head of the *pensionnat*, and two visiting physicians.

The corps of instructors consists of sixty-two professors, twelve répétiteurs and ten other instructors, distributed as follows:—1 Répétiteur of clavier for men; 1 Professor adjunct of clavier for women; 2 Répétiteurs of clavier for women; 1 Professor titular of harp; 4 Professors titular of violin; 2 Professors titular of violoncello; 1 Professor titular of contre basse; 1 Professor titular of flute; 1 Professor titular of hautbois; 1 Professor titular of clarionette; 1 Professor titular of bassoon; 1 Professor titular of horn, first and second; 1 Professor titular of trumpet; 1 Professor titular of trombone.

The classes for military music are provided with the following instructors: two of harmony and composition, one of cornet à piston, one of saxophone, one of saxhorn, two of elementary singing.

Besides the school at Paris there are five branch establishments, one in each of the following towns: Lille, Toulouse, Marseilles, Metz, and Nantes.

Four Professors of composition, contrepunt and fugue, two Professors of written harmony, three professors of harmony and accompaniment practically united, eight Professors titular of singing, three Professors titular of individual elementary singing (*solféage*) for men, four Répétiteurs of individual elementary singing (*solféage*) for men, two Professors of individual elementary singing (*solféage*) for women, five Répétiteurs of individual elementary singing (*solféage*) for women, two Professors titular of choral elementary singing (*solféage collectif*), one Professor *agrégé* teaching a class of choral music, two Professors titular of lyrical declamation in grand opera, three Professors titular of lyrical declamation in *opéra comique*, three *accompagnateurs* of lyrical declamation in *opéra comique*, one Professor for studying parts for grand opera and *opéra comique*, one Professor for the class of the *pensionnat* for studying the parts for grand opera and *opéra comique*, one Professor for teaching adults to sing popular music in the evening classes, four Professors titular of dramatic declamation, one Professor honorary of dramatic declamation, one Professor titular of theatrical management, one Professor titular of fencing for men, one Professor titular of organ and improvisation, one Professor titular of piano for men, one Professor titular of piano for women, one Professor *adjunct* of piano for women, one Professor titular of instrumental music in bands, one Professor *adjunct* of clavier for men.

We copy the following notice of the annual examination for 1866 from the *Journal of the Society of Arts*.

The examinations are divided into two series, one being held with closed



doors, and the other being open to such of the public as can obtain tickets of admission, which on some days are as scarce as tickets for a coronation, in fact, are utterly unattainable by ordinary mortals. The private examinations include sol-fa, written harmony, thorough bass, the adaptation to the piano of a piece from an old opera; scales, organ, contre basse, contre point, and fugue. This portion of the competition is carried on in the small theatre of the Conservatoire, while the public trials take place in the concert theatre; the latter include singing, grand opera and comic opera, violin, violoncello, harp, piano, and all the wind instruments played by pupils, whether civil or military, for since the suppression of the gymnasium of military music, the Conservatoire has the charge of the education of military musicians. The examination of the pupils in the dramatic classes usually terminates the public examinations.

The president of the juries is M. Auber, the director of the Conservatoire. The juries themselves are nine in number; five of these consist of professors of the Conservatoire, while the other four are selected from the artistic celebrities of the capital. The pupils in sol-fa are required to execute at sight, what is called a lesson *à changements de clefs*, and M. Elevart explains this in the following terms:—"This name is given to a particular system of notation, which introduces the seven positions of the three keys in an arbitrary manner, so as to test the promptitude of eye possessed by the competing pupils."

The pupils of the class of harmony have to arrange a selected piece with bass, and the fugue class to compose a fugue on a given subject; for this purpose eighteen hours are allotted, during which time the pupils are shut up in the class-rooms of the Conservatoire; the successful pupils rarely take more than eight or ten hours to complete their tasks. The other pupils, whether vocal or instrumental, have to execute a piece selected by the committee of studies; each kind of instrumentalists executes the same piece, and all, except the vocalist, have to execute a manuscript piece at sight.

Formerly there were vocal classes in the Conservatoire which competed in public. After having sung a morceau chosen by their professors, the pupils sang a manuscript piece at sight. M. Elevart regrets that this kind of vocal counterpoint has fallen into disuse in the singing classes, "as the study of vocalization and the obligation of executing at sight in public forced the singers to be musicians, that is to say, readers." Each pupil of the singing classes admitted to the competition sings a piece chosen by the professor. There are certain airs which are repeated ten times during one day's exhibition, such as the air of the *Deux familles* of Theodore Labarre, and that of *Norma*.

The public competitions occupy a whole week. They commence at nine in the morning and terminate ordinarily at four in the afternoon. The most popular of the musical classes are those of the violin and piano, and serious and comic opera. The scenes of tragedy and comedy performed by the pupils of the declamation classes attract a special audience. With the exception of the pit and gallery, which are nominally open to the public, admission can only be obtained by means of tickets signed by the director. These tickets are distributed amongst the Ministry of Fine Arts, the directors of the Imperial theatres of Paris, and the Professors of the Conservatoire. At the public distribution of prizes, each prize pupil receives one or two tickets, according to the degree of the prize which he or she may have obtained. At present the distribution takes place in August, a few days after the closing of the competitive examinations, but formerly it took place in November after the reopening of the classes, which are closed from the first of August to the end of September. At that time the meeting was a very interesting one; the time was sufficient to allow of the music to be performed on the occasion, being well studied; the accompaniments were given by a full band, and it was usual for the pupil who had gained the first prize in fugue in the preceding year to write the overture of the concert. At present the full band is replaced by a simple piano, and the first prize-man of the fugue class has no longer the opportunity of testing his powers in presence of a select public. The old practice of a symphony, composed for all instruments, and executed by the laureats of the year, has also necessarily fallen with the abolition of the orchestra. These melodies used to be written by eminent composers, and the names of François Bazin, Jules Cohen, and Coradin Prumier are remembered with pleasure by habitués of the Conservatoire meetings.



## MUSIC IN PUBLIC SCHOOLS.

The ability to read and render musical composition was made part of the programme of instruction in the primary normal schools, drawn up by M. Guizot, in 1833.

By the decree of 1865, the musical teaching is given during the whole three years, five hours a week being allotted to lessons in music and elementary singing, including practice on the organ and the piano.

In the lyceums vocal music was left optional with the director until 1865, when by a decree of January 30 of that year, instruction in vocal music was made obligatory on all the lower classes to the fourth inclusive, and left optional with the pupils of the fourth class and those above. The obligatory instruction includes the elementary principles of music and singing, as well as musical reading and writing, according to the notation at present in use in all civilized nations. The optional instruction may be extended to the elementary principles of harmony.

In organizing the studies of the secondary special schools, this subject was made obligatory, and the following method indicated in the elaborate circular of the Minister, (M. Duruy,) addressed to the rectors, April 6, 1868.

Singing is a powerful means of education. All the special colleges will, therefore, comprise singing classes. Each lesson should commence with singing in unison, in order to steady the voice; the pupils should be grouped according to the capacity of their voices, and each group should in its turn go through the exercises prepared. The lesson should conclude with the practice of easy and melodious choruses. As for the method to be employed, it must provisionally be the one that the master knows best how to apply.

*Preparatory year.* During this year should be taught a few principles, and many tunes of a simple and agreeable character, set to good words, but very little musical grammar.

*First year of instruction.* Each lesson should open with exercises in solfaing. The master should sing short musical phrases, which the pupils should endeavor to reproduce. These phrases should never go beyond the extent of an octave. Towards the middle of the lesson, the singing should be suspended for some minutes, during which the principles should be explained. The musical tone, scale of tones, degrees, intervals, gamut, octave, means of representing tones by signs, notes, compass, the C clef, intonation, duration, time, simple time,  $\frac{2}{4}$ ,  $\frac{3}{4}$ ,  $\frac{4}{4}$ , breve, semibreve, minim, equivalent rests. The lesson should conclude with a song sung in unison, and two-part choruses.

*Second year.* Continuation of the explanation of the principles; study of the chromatic scales, modified tones, accidents, second study of the diatonic scale, on the intervals of tones, study of the tetrachords, major and minor keys, typical scale *do* and *la*, construction of scales similar to this typical one, on the first sound of the superior tetrachord, or on the fourth tone of the inferior tetrachord, position of the sharps, position of the flats. Study of the key *fa*. Binary and ternary groups. With the lessons in theory should always be combined practice; intonation, dictation, and singing in unison should terminate each lesson.

*Third year.* Modulation, what is understood by modulating, origin of the accidentals determined by modulations, passing or durable modulations, how to distinguish between them, importance of this distinction as regards solfaing, of the seven kinds of voices, of the keys assigned to them, of the quality (*timbre*) of the voice, the enharmonic system, numerous examples borrowed from the great masters' movement, time, analysis of melody, what is meant by a musical phrase, by a period, simple and ornate melody, transposition.

*Fourth year.* Continuation of the sol-fa exercises, of musical dictations, singing in unison, and in two, three and four parts. Elementary notions of



harmony, principal consonant and dissonant accords, their fundamental position, reversal and connection, short-hand annotation of harmonies, numbered bass. Cadences, perfect, imperfect, broken, &c., suspension, use of pedals.

Accompaniment to singing. Studies of sacred music, difference between the modes of music and the modes of church music, notions of plain song, musical plain song, execution of some pieces of Palestrina, Handel, &c. Abridged history of music, æsthetical ideas resulting from the analysis of a few works of moderate dimensions selected from the Italian, French and German schools.

#### POPULAR MUSICAL INSTRUCTION IN PARIS.

The municipal authorities of Paris are making great efforts to popularize musical instruction in Paris, as has been done in Germany. Singing classes for children and adults exist in all the primary, secondary, normal and commercial schools of the capital, and an attempt is being made to give character and tone to what is taught there.

A competition is opened for choral compositions, to be executed by the pupils of the primary schools, and the classes of adults in the city. The pieces are to be written for three or four voices, without accompaniment, and a jury named by the Prefect will award the prizes. The choice of the words is also left to the composers, but they must, of course, be in accordance with the object in view. The number of pieces is to be unlimited, and a prize of three to four hundred francs, according to merit, will be awarded for each composition accepted, the copyright of the successful piece to be the property of the municipal authorities.

#### VOCAL MUSIC IN THE ARMY

Quite recently, instruction in vocal music, after the method of Galin-Paris-Chev , has been introduced at a few points in the army and navy with such success that the Minister of War in 1868 directed it to be taught in each regiment by teachers trained after this method in the normal musical class at Vincennes.

#### MUSICAL ASSOCIATIONS.

In 1867 there were 3,223, (*soci tes orpheoniques*,) with 90,532 active and 56,967 honorary members. This number does not include the philharmonic societies, nor the choral societies for the cultivation of church music. These musical associations, by their public concerts, have realized and contributed over 1,500,000 francs to charitable objects.

Many of these musical associations have founded gratuitous schools of music, which they maintain at their own expense; others have constituted themselves as mutual aid-societies. Each member receives a small book, stating the time of his joining the association, and a sort of certificate of his behavior and character. If a member, on entering a strange city, where there is also a musical association, he will at once through his book find a hospitable reception, information on all subjects of interest to him, and work.

#### ENCOURAGEMENT FOR THE HIGHEST MUSICAL COMPOSITION.

By a recent decree of the Minister of the Fine Arts, a competitive performance has been established at each of the three lyrical theatres of Paris—the prize at each for the best opera to be 3,000 francs, and for the best poem set to music, 1,500 francs. These prizes are in addition to the *grand prix de Rome*, instituted in 1802, and other prizes now awarded by the *Conservatoire*.



## SPECIAL SCHOOLS OF COMMERCE.

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### INTRODUCTION.

THE necessity of a special preparation for a mercantile career was not recognized in France until 1820, and even then, it found favor and encouragement only among merchants and bankers, who could look beyond routine to the general intelligence and knowledge of principles, which make all routine and formulas intelligible and pliable to the changing conditions of a progressive industry and an expanding commerce.

### SUPERIOR SCHOOL OF COMMERCE AT PARIS.\*

The Superior School of Commerce, the first school of its class in France, was instituted at Paris as a day-school, by two intelligent merchants, M. Brodard and M. Le Gret, in 1820; and such was the intelligence and versatility of its early pupils, that it obtained the patronage of the eminent bankers and commercial men of that day—of Chaptal, Casimir Perier, Lafitte, Ternaux and others. It was, after a few years, established in the old Hotel Sully, in Rue St. Antoine, where, endowed with numerous rooms, spacious courts, extensive gardens, a cabinet of instruments for experimental physics, a chemical laboratory, and collections of samples of merchandise, and a numerous staff of able teachers, it received boarders as well as day-scholars.

A council of improvement (*conseil de perfectionnement*), composed of very competent persons, undertook to draw up a programme of the studies, to superintend their organization, to make modifications if necessary, and to enforce their execution. The gentlemen forming this council were members of the Institute, bankers, manufacturers, merchants, who had learned by study and experience what various talents and diversified knowledge are indispensable for him who buys, sells, or manages. They traced with a firm and sure hand the regulations and programmes of the new school. Their wise arrangements have been religiously retained in the school, and

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\*Abridged from special report of M. Gervais, Director, to the Minister of Commerce, &c.

are in force to the present moment; they have served as a model and starting-point for all the attempts of the same kind which have been made in France or elsewhere. The council has constantly maintained the sound traditions of the school, which have been its main support.

The curriculum of the school requires three years of study; the pupils are divided into three forms (*comptoirs*) or classes, and no pupil passes from one form to the next without undergoing an examination.

The first year, or first form, though in some manner elementary, admits only such pupils as have received a good primary education, and are pretty well versed in French grammar, arithmetic, and geography; it is devoted to reforming their handwriting, to the study of history, geography, arithmetic in all its parts, to an elementary course on the usages of trade and the rudiments of accounts, to physics and chemistry, (of which the pupils in this form learn chiefly the elements, vocabularies, nomenclatures, and classifications;) lastly, to the knowledge of raw materials, of which the school possesses specimens and samples. In this form the pupils begin the study of foreign languages, the foreigners learn French, and the French pupils make a more profound study of the rules of their native tongue. This division of studies clearly shows that the school must have a fixed minimum of age for the pupils admitted; in fact, the understanding and memory may suffice for certain studies, but to pursue them with profit there must be attention, reflection, and judgment. The minimum age for the admission of pupils was therefore fixed at fifteen for the first form, and the school is now rather disposed to fix it later than earlier.

The second year, or second form, does not receive pupils under sixteen; it comprises the continuation of some of the preceding studies, book-keeping, the theory of accounts in all its parts, the application of arithmetic to all the operations of trade and banking, exercises in mental arithmetic, a course of correspondence, and essays intended to accustom pupils to express their thoughts rapidly with precision and perspicuity, linear drawing, geometry, the elements of algebra, commercial geography, the study of the code of commerce, the continuation of foreign languages. We have designedly indicated the limit of age for the pupils of the second form, although the rule established for entering the first would seem to render it unnecessary; it raises new difficulties for us every year, and yet must be maintained. The pupils have very generally a most decided tendency to enter the second form, careless whether



they will be able to follow its courses with profit; to leap over the elementary year is with them, and too often with their parents, a question of ambition and impatience rather than of instruction.

We have the utmost difficulty in convincing those who have obtained the bachelor's diploma (at the *Lycée*,) by dint of cramming and coaching, that the science of trade is not a unique whole, composed of formulas more or less simple, more or less numerous, which have only to be learned and remembered in order to make them at once skillful merchants. They are astonished when told that long and serious study is required to learn what they had considered so easy; they are desirous, at the very outset, to attack the highest parts of the science, to devote their attention to finance, to great mercantile enterprises and complicated operations in the funds, to attempt as mere play, the difficult and dangerous functions of consular justice. In one word, they want to reverse the natural course of things, and to begin with what can only be the end of anxious study, the result of positive knowledge and practical acquaintance with real business. It was therefore indispensable to fix a limit of age for admission to the second form, and to introduce an examination for classing according to merit, which all must pass who enter the second form without passing through the first; bachelors of sciences are alone exempt from this measure.

The third year, or third form, is the indispensable complement of the instruction given at the school; it is devoted to the higher branches of learning, and to practical exercises; it includes the study of the exchanges and of arbitration, which has been too long neglected in France, and to which the increasing number and extent of our business relations with foreign countries gives fresh importance and furnishes daily occasions for their use; multifarious applications of accounts to commerce, manufactures, and agriculture; analytical chemistry and chemical manipulations applied to the study of merchandise, and to the discovery of adulterations (thus completing the course of general chemistry followed in the two first years;) the continuation of the studies of geometry and linear drawing, the elements of mechanics applied to the requirements of commerce and industry, and to the material of trading ports, railways and docks; the technology or description of the principal manufactures, mercantile and maritime law, and political economy. In this form all the studies are applied by the simulated exercise of trade; each pupil opens and closes accounts and correspondence of all kinds. The pupils, divided into groups, or commercial firms, renewed from time to time, buy and sell

goods, keep banks, charter vessels, assure, commission, correspond, and perform, under the guidance of an able and experienced professor, all the most varied and most difficult operations. After Easter the pupils of the third form, accompanied by a professor of technology, visit the principal factories of Paris and its environs, the custom-house, bonding warehouses, &c.

It was to assist the exercises of this form that the use of fictitious bank-notes and money was at one time introduced, but these were promptly abandoned by the school as puerile expedients, proper enough perhaps to be employed for children, like the colored balls and pictures of infant schools, but altogether useless with young men bent on earnest study, and likely only to distract their attention and cause a loss of time. The same means have many times since been adopted in other schools as a new invention, but they have always been laid aside as useless.

The course of instruction in the school, as well as the allotment of time to the classes and studies, have been regulated as methodically as the multiplicity of subjects allowed. The pupils rise at half-past five all the year round, and at six commence the business of the day. They go to bed at nine o'clock. The hours of every day are employed nearly as follows: five hours in lessons, six hours in study, and four hours in recreation, including forty minutes for breakfast and dinner.

In the three forms, each course is confided to a special professor, with the exception of geometry and linear drawing, which are taught by one person, and of mechanics and technology, which are in the same case. Each pupil must attend all the courses of the form to which he belongs. He must learn at least one foreign language, and may learn several if he can find time without neglecting his other studies. The pupils are expected to take notes, as complete as possible, of the lessons given by the professors; to study them in private, to consult the authors placed at their disposal, on the same subjects, and to make a summary of the lesson, a fair copy of which they deliver in the evening to the inspector of the form, who hands it to the professor at the next lesson. Special examiners every day interrogate the pupils of the second and third forms, on the parts of the principal courses already studied; and an account is kept of the marks merited by their answers.

Every quarter there is a competition for classing the pupils in all the branches of instruction, and immediately after, the director announces the places obtained by all in the presence of the pro-



fessors and pupils. A statement of the marks merited by each pupil for conduct and application is addressed to the parents. At the end of the school-year, a board, composed of members of the council of improvement, and of the professors, awards to the two best pupils of the third form, as a first and second prize of honor, a gold medal and a silver medal, given to the school by his Imperial Highness, Prince Napoleon, as a testimonial of the great interest he takes in commercial education. The same judges award to the best pupils of the second and third forms, two silver and four bronze medals, given by the Minister of Agriculture, Commerce, and Public Works. The pupils of the third form who have completed their studies and successfully passed the final examinations before the committee delegated by the Council of Improvement, receive, when the prizes are distributed, a diploma of capacity delivered by the school and signed by the Minister of Agriculture, Commerce, and Public Works, president of the council of improvement. This is the only document the school recognizes as official, and certifying complete studies; no certificates are given for partial studies.

The organization of the management and discipline of the school is as simple as that of the studies; for the last ten years the school has received neither day-scholars nor half-boarders; all are boarders, and their number never exceeds one hundred at the same time, distributed into four dormitories and twenty private chambers, which the pupils enter only when they go to bed; all their waking hours are passed in the amphitheatres, and the class-rooms, under constant supervision.

The pupils are all warned on entering that they can remain in the school only on condition of steady application to study. They are given to understand that they come there for a commercial purpose, to purchase the instruction and instruments of their future profession. This notion is incessantly presented to them in every possible form; thus it is proved to them that they expend at the school about five francs per day, and that if each of them is not worth five francs more every night, he will have made a bad speculation, which it will be our duty to put an end to as soon as possible if no improvement should take place. The discipline of the school is not severe, but it is very strictly enforced; there are scarcely any punishments; a pupil may be kept in the half or whole of Sunday, but this must not occur often, the pupils being always warned that persistence in misconduct or neglect of study will render their dismissal inevitable; we may therefore say that the

only serious penalty is the expulsion of disobedient or idle pupils. The time which families allow the school for the development of its instruction (barely two years on the average,) is too short for any part of it to be lost in struggling against ill-regulated minds and rebellious tempers—a very meritorious work undoubtedly, but quite impracticable with the means we possess, and foreign to our object. The dismissal of a pupil, unless for very serious reasons, is not attended with any publicity; it generally takes place at the end of a quarter, when the pupil is sent home with an explanation of the circumstances. There are usually several cases of this kind every year at the end of the first quarter.

The pupils of all the divisions attend public worship under proper supervision, at the churches or chapels of the religious communion in which they have been reared.

The success of the school is due to Adolphe Blanqui, professor of the history of commerce in this school, who in 1830, in a period of great depression arising out of the disturbances of that period, came to the rescue of the institution. He was young, without fortune, had already a family to support, the times were hard, and the future gloomy; he had to accept a heritage of ruins and to stem the tide of public opinion, which was then in favor of what has long been called protection of the national industry. Nothing could deter him; he was determined to save from destruction an institution which could develop the ideas of political economy and commercial liberty to which he had already vowed his existence. He brought to its aid his indefatigable activity, his inexhaustible and charming intellect, his great learning, the numerous and useful connections attracted by the engaging amenity of his character; he contrived to restrict the school within limits more in harmony with the resources at his disposal and the perils of the moment. Followed by the pupils who admired and loved him, surrounded by a small group of professors faithful to the work, he set all an example of industry and devotedness, he labored without ceasing and shrunk from no obstacle. Indeed, when we contemplate this struggle, which lasted five-and-twenty years, and only ceased with his death, we do not know which most to admire, his courage, his activity, the variety of his acquirements, the fecundity of his resources, or the irresistible influence which he exercised over all who came near him.

From this epoch, the history of the school is the biography of Blanqui; his personality overshadowed and protected it at the same time. Deputy for Bordeaux, a member of the Institute, a brilliant



writer and applauded professor, he shed over the school the lustre of his rising fame, and gave it a world-wide reputation by his books; he drew down on it the kindly notice of the Government, whose coöperation he secured.

About 1838, M. Cunin-Gridaine, then Minister of Commerce, struck with the great services rendered by the school, and taking a deep interest in the proceedings of its classes, (at the final examination of which he was specially invited to preside,) conceived the design of giving the benefit of its instruction to a certain number of young men whose limited means would not allow them to enter. He granted several subventions in the form of half-scholarships; subsequently it was found that this measure was inadequate, and that the sums remaining to be paid by the pupils' parents were still beyond the means of the persons whom it was intended to benefit. By a ministerial decision, dated 8th June, 1853, M. Magne transformed these half-scholarships into a proportional number of whole ones, and at the instance of the present director, who had taken part in Blanqui's labors, it was decided that these scholarships should be the object of competition in the principal commercial towns, one-third of them being conferred every year. This plan has now been followed for eleven years, with the most satisfactory results. Owing to the careful supervision of these competitions by the Government, these pupils enter the school with a good preparatory education, and the best of them have always come from the superior primary schools. They soon attain good rank in their classes, where they have become an element of emulation; and three times in the last eleven years, these scholarship pupils have obtained the gold medal, the prize of honor at the school.

#### COMMERCIAL SCHOOL OF CHAMBER OF COMMERCE.

In 1863, the Chamber of Commerce of Paris, with the encouragement of the Minister of Public Instruction, established a special school where day-scholars, whose parents reside in the city, can be prepared for the special requirements of railway, navigation, and telegraphic companies, and for commercial service generally.

The course covers three years, with a preparatory class for lads under twelve years, and a fourth year for such as desire to pursue for another year the special studies of a commercial career.

The studies, besides the general course, suitable for the period between thirteen and sixteen years, include commercial geography and history, technology, book-keeping, exchange, foreign monies,

weights and measures, commercial correspondence, commercial law, English, German, and Spanish languages, and drawing.

At the end of the third year the pupils are examined, and if qualified, receive certificates of their capacity and proficiency; and at the end of the fourth year the Chamber of Commerce awards a diploma to those who, during that trial-year, give proof of real business knowledge and aptitude.

Special prizes are offered by the Minister of Public Instruction, and the Chamber of Commerce, the competition for which is widely felt, and the award is a sure passport to immediate employment.

Each scholar pays twenty francs in advance, which cover all expenses except books. The prizes, and subsidies by the city and State, and larger business firms, meet the wants of capable but indigent pupils.

There are accommodations for four hundred day-pupils. In the evening there are lectures for adults.

#### COMMERCIAL EDUCATION IN PUBLIC SCHOOLS.

In the great municipal secondary schools of Paris, the Chaptal and Turgot, special attention is paid to studies which prepare for a mercantile career, in which many of the graduates will at once enter. Modern languages, English, German, Spanish and Italian are taught in place of Greek and Latin, and exercises in penmanship and arithmetic bear upon commercial forms, book-keeping, and business transactions. Geography and natural history are taught in reference to the manufacturing resources and the industries of nations.

In the organization of secondary special instruction, the Minister requires the commercial section to pursue the following:—

During the *first year*, (about the thirteenth year,) general notions on the nature of commerce, and of credit, definition of the principal terms used in mercantile and money transactions, business forms with practice in making neat examples of them. *Second year*: commercial geography of France and details in regard to articles of commerce, commercial arithmetic, a course preparatory to book-keeping, with practice in keeping a day-book. *Third year*: commerce of foreign countries, principles of book-keeping, practice with ledger and journal. At the close of this year the pupil is to be a good book-keeper. *Fourth year*: financial and commercial history and legislation, classes of men and companies employed in commerce and finance, partnerships, bankruptcies, &c., ending with rules of competency of maritime tribunals.

The whole school must be instructed in *legislation usuelle*, the constitution of the government, functions of each department, the peculiarities of a city or other municipality, how the army is recruited, taxes raised, and the law administered, the civil relations of marriage and parentage, the inheritance, tenure, partnership, and transfer of property, insurance, both of life and property, and the laws generally which affect the citizen in his public and private transactions.



*Specimen of the Programme of the Course on "Législation Usuelle" in the newly-organized Secondary Special Instruction (Enseignement Secondaire Spécial) in France.*

## LEGISLATION USUELLE.

PRELIMINARIES.—Necessity of a public legislative authority for all classes of the population. Without public authority and without legislation, there can be neither order nor justice. Essential attributes of the public authority. Different organizations according to the people and the times. Varied object of all legislation. Public and administrative right. Private right (civil and commercial.) Penal right.

## I. PUBLIC AND ADMINISTRATIVE RIGHTS.

PUBLIC RIGHT.—Constitution of January 14th, 1852, and decrees of the Senate (*Sénatus-consultes*) of Nov. 7th and Dec. 25th, 1852.

*Fundamental principles of public right*:—National unity. Rights guaranteed to all the citizens. Obligations imposed on all citizens.

*Organization of public authority* :\*—Its basis: The Emperor hereditary head of the State. The Senate. The Legislative Assembly (*Le Corps Législatif*.) The Council of State. Judiciary authority. Administrative authority.

*The Emperor head of the State*:—General view of the nature of his prerogatives in every thing which concerns the relations between France and other nations (treaties of peace, alliance, and commerce,) in every thing which concerns internal government, his relations with the Senate, the Legislative Assembly, and the Council of State. Head of the executive power. His prerogatives. Maintenance of the reciprocal independence of the administrative and judiciary authority.

*The Senate*:—General views of its organization and privileges.

*The Legislative Assembly*:—General view of its composition, election, and prerogatives.

*Judiciary Authority*:—Its general prerogatives. Principles of its organization. Territorial divisions for the administration of justice. Ordinary jurisdiction on civil litigations and criminal affairs. Special jurisdiction. Court of appeal. Objects of its institution.

*In what forms do the organs of public authority act?*—Decrees of the Senate. Laws. Decrees and regulations of public administration. Decrees (*arrêtés*.) Sentences and decrees (*jugements et arrêtés*.)

ADMINISTRATION.—*Administrative Division of France*:—Constitutional principles. Centralized subordinate administration. Administrative division of France into Departments, Districts, (*Arrondissements*,) Cantons, and Communes. The administration is *active*, *i. e.* acts, deliberates, and judges the litigations which arise by occasion of acts, *consultative* and *debateable* (*contentieuse*.) Administrative action is generally confided to one agent. The deliberation belongs to the assemblies and councils. The exercise of jurisdiction does not belong exclusively to the assemblies or councils.

The central administrative action belongs to the Emperor and the ministers. The Council of State deliberates.

At the centre of the Department, the authority is in the hands of the prefect. Deliberating bodies: the council of the prefecture and the general council.

At the head of the *arrondissements*, the sub-prefect; the council of the *arrondissement*.

At the head of the commune, the mayor; the municipal council.

*Of the Emperor, the supreme head of the administration*:—What are his powers with regard to the *personnel* of the administrative agents, as regards public services or administrative matters.

*Of the Ministers*:—Ten Ministries: State; Justice; Foreign Affairs; Interior; Finances; War; Marine and Colonies; Public Instruction; Agriculture, Commerce, and Public Works; Imperial Household and the Fine Arts. The

\* This Abstract of the Constitution and Law as they were in 1867 may not answer for the year 1870.



ministers are charged with the execution of the laws. Their authority is exercised by means of decrees (*arrêtés*) or instructions for the organization or execution of public services, and by individual decisions concerning particulars.

*Of the Council of State*:—Its organization; the different nature of its prerogatives.

*Of the Prefects*:—Of the prerogatives of the prefect as agent of the government and representative of the Department.

Some remarks on the decrees of prefectural decentralization of March 25, 1852, and April 12, 1861.

*Of the General Secretaries of Prefectures.*

*Of the Councils of Prefecture*:—Their composition; their prerogatives. They give advice; they assist the prefect in the exercise of his administrative functions; they authorize persons of moral character to plead; they are judges of administrative litigation (*du contentieux administratif*).

*Of the General Councils*:—Their composition; a councilor for each canton; mode of nomination.

The general council assists, enlightens, and controls the prefects in the management of the special interests of the Department.

Ordinary and extraordinary sessions of the general councils. Four ways of deliberating, viz., 1, executive deliberations independently; 2, executive deliberations with the approbation of superior authority; 3, advice; 4, wishes. General views of the Departmental budget.

*Of the Sub-Prefects*:—Chiefs of active administration in the arrondissements. They have only exceptionally a direct authority over the citizens. Leading characteristic. Agents of transmission between the prefects and mayors or citizens.

*Arrondissement-councils*:—Their composition; their relation to the repartition of contributions among the communes. For the surplus only the privilege of giving advice.

*Mayors and Assistants*:—Nominated by the Emperor or the prefect. Privileges of various kinds with which the mayor is invested. Two kinds of administrative prerogatives: 1, agent of the government; 2, representative of the special interest of the commune.

As agent of the government the mayor is charged with the publication and execution of the laws or regulations.

He exercises a direct authority in various matters. He has special charge of the municipal and rural police. He can, under the superintendence of higher authorities, pass resolutions both as regards regulations (permanent or temporary) and individuals.

The mayor is the highest local authority of the commune. His duties. Prerogatives of the assistants.

*Municipal Councils*:—Their composition and nomination. At least ten members, at most thirty-six, according to the population. Municipal elections. Renewing of the municipal councils. Four ordinary sessions; their duration; extraordinary sessions. Four kinds of deliberation in the municipal councils, viz., 1, executive deliberations; 2, deliberations submitted to the approbation of a higher authority; 3, advice; 4, wishes.

*Of the Communal Budget.*

General views of the administrative auxiliary agents for the different branches of the public service.

#### *Administrative Matters.*

Extent and importance of the public service in France. Inducements to enter.

*The Army*:—Mode of recruiting; cantonal contingent; drawing by lot. Of the council of inspection (*examination*;) causes of exemption; maintenance of the family. Of exoneration from military service by providing substitutes; by substitution of numbers. Composition of the army; reserve, national guard.

Advancement of soldiers by choice or by length of service; of the grade which is a property. Of the employ which is facultative for the government. Inactivity. Of reform; of pensions; recruiting for the navy; maritime conscription; iron-clad fleet and sailing vessels.



*Worship*:—General views of the ecclesiastical organization of France. Catholic worship; archbishoprics, bishoprics, parsonages, parishes. Reformed church; Church of the Confession of Augsburg; Israelite worship; Mohammedan worship. Organization of these various modes of worship.

*Public Instruction*:—Special administrative organization for public instruction. Primary instruction; public and free schools; normal schools; secondary instruction, classical and special; communal colleges; lyceums; superior instruction; special establishments; College of France; Museum of Natural History; Imperial Observatory; Bureau of Longitudes; the Institute; libraries and museums.

Special schools of the Ministries of War, Navy, Finances, and Public Works.

*Public Works; Draining of Marshes; Mining and Quarrying*:—Public works, properly speaking. Different classes of public works. Civil works (bridges and turnpikes, civil buildings.) Military works. Maritime works. Works belonging to several classes. Various agents charged with the superintendence of public works and their execution. Rendering of service imposed on property for the carrying out of public works. Expropriation for the public benefit. Declaration of public utility by the administration. Register of lands divided into small properties (*plan parcellaire*.) Judgment of expropriation. Previous indemnity. The indemnity fixed either amicably or by a jury of expropriation. Occupation of ground for excavations, extracting of materials (for building) and for depots, necessary for the execution of public works.

Special legislation for works of military defense. Review of legislation on the rendering of military services.

Legislation regarding the draining of marshes.

Legislation regarding mining and quarrying; definition of these two terms; concessions for mines. Permission to explore property which holds metals. Superintendence of quarries.

In the programme of industrial legislation, to mention all that concerns dangerous, unhealthy, and inconvenient establishments, the patents of invention, the trade-marks, &c.

*Department of the public service which has the superintendence of the Roads, (Voirie.)*

Imperial, departmental routes, railroads, navigable rivers; cross-roads, country roads, streets and squares.

Rendering of services for public use imposed on landed proprietors having possessions along high-roads; laying out by a line; towing-paths.

#### *Public Property and Finances.*

Expenses and resources of the State; ordinary and extraordinary expenses; budget of the State; its composition; prerogatives of the Minister of Finance as regards the management of the public property; central and local agencies for the administration and collection of public revenues; resources; general views on the national domain; public domain, state domain, crown domains.

Taxes; their importance among the resources of the State; common principles of taxation; various kinds of taxes; explanation of the terms, direct and indirect taxes.

Direct taxes; direct taxes, properly so called; other taxes.

Four kinds of direct taxes, viz., 1, landholders' tax; 2, personal tax and tax on moveables; 3, tax on doors and windows; tax on patents. Distinction between the taxes of repartition and the taxes where every one pays his quota (*quotité*.)

General notions on landholders' taxes; the register of lands.

General notions on personal taxes and taxes on moveables; on taxes on doors and windows; taxes on patents.

General notions on the making out of the lists; their publication.

Authorized ways of making out the lists; various pursuits; protestations; demands of discharge or reduction; demands for delivery or reduction; what distinguishes them.

Indirect taxes comprise principally the taxes on liquors, salt, sugar, on registering, on stamps, on customs, the monopoly of the mail service, tobacco, and powder.

Taxes on liquors; license to trade; rights of entering; of leaving; of permit (*passavant*;) passing without paying duty (*passé-debout*;) of transit; of practice (*exercice*;) individual or collective subscription (*abonnement*.) Summary notions on the taxes on salt and sugar.

Registration. The rights of registration are fixed or proportioned. In some cases the one, in others the other. In the matter of heavy title-acts and gratuitous title-acts; the rights of change (*mutation*;) rights of obligation in civil or commercial matter, rights of discharge.

Stamps; stamp of dimension; proportional stamp; sanction.

Public expenses; general views; how controlled; why they are justified; regulation of the budget; balancing of accounts; prerogatives of the court of accounts.

Of the programme of industrial legislation all that concerns the customs, the monopoly of tobacco, stamped paper, powder and saltpetre, of the mail-service.

#### *Administrative Justice.*

*Nature of administrative litigation*:—It comprises claims raised against administrative acts, for violation of the obligations imposed on the administration by laws or regulations to which it is subjected or of contracts which it has made.

*Administrative jurisdiction*:—General notions on the competency of certain authorities as regards the most common matters; prefects; councils of prefecture; ministers; council of state.

Of the recourse that may be had to the council of state for transcending power on the part of subordinate authorities.



# AGRICULTURAL EDUCATION

IN

FRANCE.

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**THE** great industrial interest of agriculture is wisely recognized and cared for by the government of France in the following manner:

1. There is not simply a bureau with a clerk, but a department with a secretary or minister, to collect and disseminate information as to the condition and improvement of agriculture, and the agricultural population, and to administer all laws which may be passed on the subject. An annual report, statistical and suggestive, is made by the minister.

2. Agricultural inspectors are employed; some to visit foreign countries, gather information, and import plants and seeds, and improved stock, to be disposed of at public sales; and others to visit particular districts of the country, and communicate information and advice, as they may see that they are needed.

3. Encouragement is given to agricultural societies and shows. In 1850, there were over one million of members enrolled in the various central, departmental and local societies, for the promotion of horticulture and agriculture. Premiums are offered for improvement in every branch of agricultural industry.

4. In the Conservatory of Arts and Trades, provision is made for a collection of models and drawings of agricultural buildings and implements, and for courses of gratuitous lectures on the principles of chemistry and mechanics as applied to agriculture.

5. The government has organized an extensive system of agricultural and veterinary instruction, and makes liberal appropriation for its support.

The earliest effort in Europe to provide for special instruction in agriculture, was made by Abbe Rosier in France, who submitted to Turgot, minister of Finance, in 1775, a "Plan for a National School of Agriculture in the Park of Chambord," and again to the National Assembly in 1789. After his death, the plan was submitted to Bonaparte, but without success. In the mean time, Fellenberg opened an institution in Switzerland. The first experiment in France was made by M. de Domsbasle at Roville, in 1822, which, for want of sufficient capital, was abandoned in 1842. Its success was such as to lead to the establishment of the Royal Agronomic Institution at Grignon in 1827, the Institute of Coetbo in 1830, of the school at Grand Juan in 1833, and the model farm of Saulsaie in 1842. In 1847, there were twenty-five agricultural schools in operation; to several of which orphan asylums and penal colonies were attached. At the close of that year, the government introduced a measure for the better organization of agricul

tural instruction, which was voted by the National Assembly on the 3d of October, 1848, and the sum of 2,500,000 francs was appropriated to carry its provisions into execution.

#### AGRICULTURAL EDUCATION.

The law of 1848 provides for three degrees of professional instruction in agriculture at the expense of the State. 1. A farm school in each (86) department, and ultimately, for each (363) arrondissement. 2. A higher seminary, called a District or Regional School, embracing two or more departments; and 3. A National Agronomic Institute, a sort of normal school of agriculture.

#### MODEL FARM SCHOOL.

The farm school is a rural enterprise, conducted with ability and profit, in which the pupils perform all the labor, and receive a practical course of instruction in agriculture. The objects aimed at are: *first*, to furnish a good example of tillage to the farmers of the district; and *second*, to form agriculturists capable of cultivating intelligently, either upon their own property or that of others, as farmers, managers, overseers of cattle, &c.

The school is open to pupils who are at least sixteen years of age, have a good constitution, and have received an education in the primary schools. Each school must have at least twenty-four pupils, before it can receive aid from the government. The aim is to have pupils enough on each farm to carry on all its operations in the field, nurseries, and gardens, without any other help, except that of the teachers.

The officers or teachers selected and paid by the government, are a *director* with a salary of 2,400 francs; a *head workman* with a salary of 1000 francs; a *nursery gardener*, with a salary of 1000 francs; a *veterinary surgeon*, with a salary of 500 francs; besides these, in some of the schools, there are special assistants, such as shepherds, silk-growers, &c., &c.

The practical course extends through three years. The first is devoted to simple manual labor; the second to the charge of animals; and the third to the oversight of various operations on the farm. The hours appropriated to study are devoted, 1st, to copying and writing out the notes taken of the instructions of the different leaders: 2d, to reading a manual of elementary agriculture; and 3d, to lessons given by the overseer of accounts, on arithmetic, book-keeping, and surveying. Religious instruction is given by the clergy in the neighborhood.

The director works the farm at his own risk, and must so conduct it, as not only to give as good examples of tillage, but as profitable return of crops, as other farms in its neighborhood, otherwise the patronage of the government is withdrawn.

Pupils are boarded and instructed without charge, and are also allowed a small sum toward clothing. Prizes are also awarded for good conduct and proficiency.



Seventy-one Model Farm Schools were in operation in 1851, with over 1,500 students in attendance on a course of practical instruction extending through three years.

#### DISTRICT, OR REGIONAL SCHOOLS OF AGRICULTURE.

France is divided into a number of agricultural districts, in each of which there is to be a District School of Theoretical and Practical Agriculture. They have three objects in view:

1. To form enlightened agriculturists, by teaching them the principles of agriculture.

2. To offer an example, or model, of practical agriculture of a high order, and constantly advancing.

3. To make experiments for improving the cultivation of the soil.

The instruction in these schools is of a much higher order than in the farm schools, and is adapted not to prepare laborers on the farm, so much as men to direct agricultural affairs. The farm connected with the school is expected to present an enlightened system of culture, and to adapt that culture to the wants and peculiarities of the district in which it is situated. The director, also, is no longer a farmer, or proprietor, laboring at his own risk, but an agent employed by the government, and accountable to them, and subject to their direction.

The instruction is both theoretical and practical, embracing the following six professorships:

One professor of rural economy and legislation.

One of agriculture.

One of zootechny, or the economy of animals.

One of sylviculture, (cultivation of forest trees,) and of botany.

One of chemistry, physics, and geology, applied to agriculture.

One of rural engineering, (irrigations, rural constructions, surveying, &c.)

The course on rural economy and legislation describes the relation between rural productions and the public revenue, as well as the different branches of industry. It shows what circumstances are favorable or unfavorable to such or such a system of cultivation, or to such or such a speculation in animals, or vegetables, according to the situation of the lands, the facility of communication, and demand for the products by the people of the surrounding country. The course embraces also rural legislation.

The course on agriculture embraces the study of the soil, of manures, of instruments of tillage, of different cultivated plants, an estimate of the different modes of culture, and the theory of the distribution or rotation of crops.

Zootechny treats of the production and amelioration of animals. The professor gives at first some ideas of anatomy and physiology generally, and then treats, in a practical way, of the raising of domestic animals, of their support, of their amelioration, of their hygiene, and their production.

The professor of sylviculture and botany gives first, a summary sketch of vegetable physiology and botany applied to agriculture. He teaches the subject of sylviculture, (cultivation of woods,) and of forest economy, with special reference to the training, working, and preservation of the forests of individuals and the communes.

The professor of chemistry, physics, geology, &c., has a wide field, as his titles show. His chief object is to take those views of the sciences named which bear directly upon agriculture.

The professorship of rural engineering embraces geometry, mechanics, and linear drawing, as applied to rural architecture, to the construction of agricultural instruments, and particularly to irrigations.

To second the lessons of the professors, an equal number of tutors are appointed. Their duties are to explain in private, to the pupils, whatever is obscure or difficult in the oral instruction. They also see that notes are taken of the lectures, &c.

Each school has its library, its philosophical and chemical cabinet, adapted especially to agriculture, its agronomic museum of geology, zoology, botany, and agricultural technology.

The pupils have an opportunity of witnessing on the farms connected with these schools, all the important agricultural operations, also specimens of the best breeds of animals, and the mode of taking care of them, and using them: and they engage personally in all the important operations connected with husbandry, so as to know how to conduct them in after-life.

The number of scholars admitted is fixed by the government, and varies at the different schools. The price of board is 750 francs, (\$138.)

The State furnishes several scholarships to each school. Half of them is given to the most deserving of the pupils from the farm schools, placed at the regional schools. The other half is divided among the scholars who are the most distinguished, after six months' trial, for their labor and conduct. Scholarships from the national agronomic institute, are also given to those most successful in study and conduct.

Towards the close of the third year, examinations are held, and to those who sustain them, diplomas are given, and the way is laid open for their admittance to the national institute.

To these schools a farm is always attached, for the purposes already indicated; also, a manufactory of agricultural instruments, an establishment for silk, a place for preparing liquid manures, distillery, oil mill, dairy, sawmill, &c.

The head men on the farm are essentially the same as those already described as connected with the farm schools.

#### NATIONAL AGRONOMIC INSTITUTE.

To give unity and efficiency to the system of agricultural instruction, the law provides for the establishment of a National Agronomic Institute on a portion of the magnificent garden of Versailles. Suitable buildings, and a library, laboratories, and appropriate collections of spe-



cimens, models and drawings, of implements, animals, seeds, plants, &c. are to be provided by the government. The plan embraces

1. A complete faculty of agronomic science.
2. A superior normal school of agriculture.
3. A higher institute for agriculturists.

To meet the wants of this latter class especially, a large farm is connected with the school. Here will be performed, at the expense of the State, all the experiments necessary to the progress of agronomic science, and to verify practically all the innovations and improvements proposed by others, before they are recommended to the public.

The theoretical and practical parts of this institute are really distinct, but they are placed under the general government of one director.

The professorships are nine, as follows:

One chair of rural economy and legislation.

One of agriculture.

One of zootechny, or the economy of animals.

One of sylviculture.

One of rural engineering, embracing leveling, irrigation, construction of roads, rural architecture, and mechanics applied to agricultural instruments.

The above professorships belong to practical agriculture. The others belong to the theory of the subject.

One of terrestrial physics and meteorology.

One of chemistry applied to agriculture.

One of botany, and vegetable physiology.

One of applied zoology.

Here, as in the lower schools, a number of tutors is appointed equal to the number of professors.

In addition to the director, professors, and tutors, the following officers will be appointed:

A prefect of studies.

A curator of the collections.

A librarian.

An overseer of studies.

To these will be added a corps of head men to oversee and manage the affairs of the farm. These will, in part, be called from the farm schools. For example, the institute will need twenty-one herdsmen, twenty-one grooms, twenty-one shepherds, and fifteen gardeners.

The French minister adds, "The end of the institute at Versailles, is not merely to afford agricultural instruction, but to open the way for studious men, who wish to direct their labors toward the application of science to rural industry. This is the first attempt of the kind that has been made. Industry has enriched the learned men who have explored the domain of the physical sciences and of chemistry for this object. But if agriculture has given reputation to any, it has not procured for any one a position which would enable him to make that the center of his studies. The institute at Versailles is intended to change this state

of things by offering as a prize of laudable ambition, to those who direct their researches to agriculture, a certain number of chairs, before which an immense field opens."

#### VETERINARY EDUCATION.

In addition to the above system of agricultural education, the government of France maintains three institutions (at Lyons, Alfort, and Toulouse,) at an expense of over \$75,000 a year, to qualify persons by the study of comparative anatomy and physiology, and by opportunities of witnessing hospital practice, and investigating the symptoms and phenomena of disease in domestic animals, to practice veterinary surgery and medicine. In countries where a large number of horses are required for cavalry service, and in all countries where live stock constitutes so large a portion of the motive power and capital of every agriculturist, there should be one or more institution of this kind. The first in the world was established at Lyons in 1762; the second, at Alfort in 1766; the third, at Berlin in 1792; and the fourth, at London in 1793.

#### VETERINARY SCHOOL AT ALFORT.

The Veterinary school at Alfort was instituted in 1766. It is beautifully situated on the river Seine, about six miles from Paris, and embraces every facility, of building, anatomical specimens and preparations, books, and professors, for a complete course of instruction in veterinary medicine and surgery. The following sketch of the school is taken from Mr. Colman's Report:

A student at his entrance must be well versed in the common branches of education; and a full course of instruction requires a residence of four years. The number of pupils is limited to three hundred. Of these, forty are entirely supported by the government. These are educated for the army; and are required not only to become versed in the science and practice of veterinary medicine and surgery, but likewise in the common business of a blacksmith's shop, as far as it is connected with farriery. Students can be admitted only by the nomination or with the consent of one of the great officers of government, the minister of commerce and agriculture. The expense of board and lodging is about fifteen pounds, or eighty dollars a year; the instruction is wholly gratuitous, the professors being supported by the government.

The establishment presents several hospitals or apartments for sick horses, cows, and dogs. There are means for controlling and regulating, as far as possible, the temperature of the rooms, and for producing a complete and healthy ventilation. There are stables where the patients may be kept entirely alone, when the case requires it; and there are preparations for giving them, as high as their bodies, a warm bath, which, in cases of diseased limbs or joints, may be of great service. There is a large college with dormitories and dining-rooms for the students; houses for the professors within the inclosure; rooms for operations upon animals, and for anatomical dissections; a room with a



complete laboratory for a course of chemical lectures; a public lecture room or theater; and an extensive smithery, with several forges fitted up in the best possible manner. There are likewise, several stands, contrived with some ingenuity, for confining the feet of horses, that students may make with security their first attempts at shoeing, or in which the limb, after it has been separated from its lawful owner, may be placed for the purpose of examination and experiment.

An extensive suite of apartments presents an admirable, and, indeed, an extraordinary museum both of natural and artificial anatomical preparations, exhibiting the natural and healthy state of the animal constitution; and, likewise, remarkable examples of diseased parts. The perfect examples of the anatomy of the horse, the cow, the sheep, the hog, and the dog; in which the muscular integuments, the nerves, the blood-vessels, and, indeed, all the parts, are separated and preserved, and exhibited, by the extraordinary skill of an eminent veterinary surgeon and artist now deceased, who occupied the anatomical chair of the institution, exhibited wonderful ingenuity in their dissection and preservation, and present an interesting and useful study, not to the medical students only, but to the most ordinary as well as the most profound philosophical observer. I have seen no exhibition of the kind of so remarkable a character.

The numerous examples of diseased affections, preserved, as far as possible, in their natural state, strongly attract observation, and make a powerful appeal to our humanity in showing how much these poor animals, who minister so essentially to our service and pleasures, must suffer without being able to acquaint us with their sufferings; and how often they are probably compelled to do duty, and driven to the hardest services by the whip or the spur, in circumstances in which a human being would not be able to stand up. A great number of calculi or stones, taken from the bladders of horses after death, are exhibited, of a large size, and, in some instances, of a very rough exterior, which must have excessively irritated and pained the sensitive parts with which they came in contact. It is scarcely possible to overrate the suffering which the poor animal must have endured under such an affliction.

The department for sick dogs, containing boxes for those which require confinement, and chains for such as require to be kept in the open air, and a cooking apparatus and kitchen for the preparation of their food, was spacious, well-arranged, and contained a large number of patients. Any sick animals may be sent to the establishment, and their board is to be paid at a fixed rate of charges; twelve sous or cents, or sixpence per day for a dog; and fifty sous or cents, or twenty-five pence, for a horse, including medicine, advice, and attendance. In cases of epidemics or murrain prevailing in any of the districts of France, the best attendance and advice are sent from these schools to assist in the cure, and especially to watch the symptoms and progress of the malady. In countries where large standing armies are maintained, and where of course there are large bodies of cavalry and artillery to be attended

upon, as well as waggon-horses for carrying the supplies, the importance of veterinary surgery is vastly increased; but in countries where no standing armies exist, the number of horses kept for use or pleasure, and of other domestic animals, bears a much larger proportion to the number of human beings than we should be likely to infer without inquiry; and renders the profession highly important.

A large and select library belongs to the establishment, and a garden for the cultivation of medicinal plants, and likewise of the grasses employed in agriculture. A farm is likewise attached to the place, on which instruction is given in practical agriculture, and numbers of various kinds of animals are kept for the purpose of breeding the best, and illustrating the effects of crossing. Some selected animals of domestic and of the best foreign breeds, horses, bulls, cows, and sheep, are kept for this special object.

#### AGRICULTURAL REFORM SCHOOLS.

In addition to the special schools of agriculture and the associated arts and sciences above described, there is a class of institutions not only in France, but in Germany, which are instrumental in diffusing a large amount of practical instruction in farm and garden industry, while they are accomplishing a still higher purpose in cultivating the long neglected or abused souls of their pupils—we refer to the Reform Farm Schools, of which a particular account will be given further on.

Mr. Coleman, in his *European Agriculture*, after giving a brief description of Mettray, as an agricultural institution, remarks: "When one looks at the innumerable herds of children, turned, as it were, adrift in a great city, not merely tempted, but actually instructed, stimulated, and encouraged in crime, and observes them gradually gathering in and borne onwards on the swift current with increasing rapidity to the precipice of destruction, until escape becomes almost impossible, how can we enough admire the combined courage, generosity, and disinterestedness, which plunges in that it may rescue some of these wretched victims from that frightful fate which seems all but inevitable? I do not know a more beautiful, and scarcely a more touching, passage in the Holy Scriptures than that which represents the angels in Heaven as rejoicing over a repenting and rescued sinner. It is, indeed, a ministry worthy of the highest and holiest spirits, to which the Supreme Source of all goodness and benevolence has imparted any portion of his Divine nature.

"If we look at this institution even in a more humble and practical view, as affording a good education in the mechanical and agricultural arts, its great utility can not be doubted: and much good seed will be sown here, which, under the blessing of God, is sure to return excellent and enduring fruits.

"I should have said before, that there is connected with the institution a hospital which was a model of cleanliness, good ventilation, and careful attendance; all the services of which were rendered by those indefatigable doers of good, the Sisters of Charity."



## VISIT OF LORD LEIGH TO THE REFORMATORY ESTABLISHMENT AT METTRAY.

THE following notice of the establishment at Mettray is from the pen of Lord Leigh, who has employed a short visit in France in the useful object of gathering personal experience and information of the various institutions of this class in the country of our neighbors and allies. They were addressed in a letter to a member of the committee employed in carrying out the plans of such an institution in Warwickshire, in which the noble writer has from the first taken an active part. The letter, intended only for the use of those acting in his own country, may be equally useful to others.

“ According to your request, I propose to send you a short account of one or two of the reformatory institutions which I have seen in France, but I shall confine my observations chiefly to Mettray. The conduct of the Colonie Agricole of Mettray has the advantage of resting entirely with our admirable friend M. Demetz, who first set the institution on foot about 17 years ago, in company with a friend, the Vicomte de Bretignières de Courteilles. It has been supported by private subscription, by his own and his friend's benevolence, and by assistance from government at the rate of 70*c.*, or 7*d.*, per head a day, with a gift of 35*f.* on the admission of the child into the colony, and 35*f.* at the close of two years more, with an annual subscription of 50,000*f.* or (2,000*l.* English money,) lately diminished to 25,000*f.* or 1,000*l.* The present number of children is 681, and of *employés* fed at the expense of the institution, 56. The buildings stand in the middle of a flat open plain, remote from any town or large village, without wall or enclosure of any sort, for the purposes at least of confinement. The church stands in the middle of the buildings at the further end. It is open at all times, but service is only performed in it on Sundays. M. Demetz observed on this point that he objected to daily service, on the ground that workmen in every day life would be unable to attend it, and that to drop a duty which had been inculcated as one had an injurious effect upon the mind. The *colon*, when first he found himself unable to attend daily service, would feel that he was neglecting a duty, and when at war with his own conscience would soon give up going to church at all. In speaking also of La Grande Trappe, which is in the hands of monks, M. Demetz said that, although he had not seen it, he feared upon this principle that it was probable, that when once the young *détenu* restored to the world found out how dissimilar real life was from what he had hitherto seen of it, and the impossibility of carrying out the religious practice to which he would have been most likely trained in La Grande Trappe, there would be great danger that his eyes over-opened, and the constraint once removed, he would become wholly reckless and neglectful of the observances which the lawful business of the world still gave time for.\* At the same time, the children have full liberty, the church doors being open, if they wish to spend a few minutes in prayer to do so, but if they desire to do this it must be during the hours placed at their disposal for play. These hours are the hour after dinner and the two half hours after breakfast and tea.

The boys are divided into families of, in general, from thirty to fifty each, to which families they remain attached during the whole period of their detention; and when they return to visit Mettray, when out of a situation, they invariably seem to turn again to their old family. We ourselves saw a promising young soldier who had been wounded in the Crimea, and was now quartered at Tours, revisiting his old haunts and the house in which he had been brought up, and when the children were being marshaled—as they always are to the sound of music in marshal order preparatory to meals or return to labor—assisting in get-

\* As this observation of M. Demetz is founded on a mistake as to fact, I beg leave through your wide-spread journal to inform the public, from personal knowledge, that the *détenus* at La Grande Trappe hear mass only on Sundays and holidays, as at Mettray, that the system pursued at La Grande Trappe is mainly the very same as at Mettray in every respect, with this exception,—that the brothers of the third order who work the reformatory at La Grande Trappe have no pay, but volunteer their services out of charity.—*Letter to Editor of Times by George B. Burder.*



ting the little ones of his former family into their proper rank and place. There are twelve houses, (exclusive of the farmhouses,) for the boys, divided into three stories; the two upper form the sleeping and living rooms, while the ground floor is used for a workshop; the family division, however, is not carried out in the workshops, as boys of various families are brought together to learn the same trade. M. Demetz observes that it is very desirable to teach boys who come from towns, and who belong to families practicing them, trades, as he says that he has found by experience and former failures the impossibility of inducing town boys to attach themselves to country life. He started with the idea that he might exclude trades altogether, but his long experience has taught him that this did not answer; nevertheless, he makes a very great point of agricultural occupations, and something rather less than half the whole number of children are employed directly upon the farms. To return to the family division, to which I conceive the success of Mettray to be greatly due. I am of opinion that this system alone allows of attention to every individual child, which is indispensable to the reformation of each individual character, while it procures for children, who have perhaps never experienced them before, the happy influences inspired by the love of home. A *chef de famille* or *employé* has the constant superintendence of one of these families. He is assisted by one of the *élèves*, or young men in training to become masters hereafter, who does not, however, remain permanently attached to one family; and by two *frères aînés*, who are chosen from among and by the boys themselves.

The *frères aînés* are in the position of monitors, and are distinguished by a red mark upon the sleeve of their jackets. M. Demetz is at very great pains, in introducing new boys, to place them judiciously as regards the families. For example, in France there is a great difference of character observable in different provinces, and he takes care that the volatile nature of one disposition shall be balanced by the steadiness, not to say stolidity, of another. The family division presents great advantages on the introduction of any number of boys into the institution; for when there is an accession of bad boys—who, if turned in with ever so great a number of others, would remain a nucleus of evil, attracting all the evil round it till it swelled and corrupted the whole mass—by a careful subdivision, and by introducing but one or two boys into a family of improved and improving character, the spirit of evil is probably soon repressed by the preponderating good around, and no permanent injury is done. To return to the *chef de famille*. He occupies a little closet at the end of the children's bedroom, which is in shape an elongated square; therefore, it is the more possible for him to overlook the whole through a little window opening into his room, added to which the children lie with head and feet alternating. No conversation whatever is allowed during the hours for work, meals or sleep. The hammocks, (which the children at Mettray all sleep in,) were recommended to us on many grounds, although I am not prepared to give a decided opinion myself upon them. M. Demetz said that in summer the boys lie in them in comfort and decency, with scarcely any covering whatever, and in winter very little makes them snug and warm, not to mention the great economy of material and of space. The supports for the hammocks on the outer side are in the day time hooked to the walls, and at night, at a given signal from the *chef*, are dropped into grooved supports, projecting from the posts which support the roof and stand out in the room. Though stout beams, they were easily lifted by the children together. All retire to rest at the same hour, only the little ones get up later in the morning. A light is kept burning in the rooms all night. Half the children sleep on one floor, half on another. The *chef de famille* sleeps near one half, and the *élève* near the other. The children have three meals a day—meat twice a week. The cost of their diet averages forty-five centimes, or  $4\frac{1}{2}d.$  The trades the children learn are various—tailoring, shoemaking, *sabot* making, with blacksmiths', wheelwrights', and carpenters' work; and they also make agricultural implements. They take turns to assist in the domestic services of the house and kitchen. Washing is done every day in an admirably organized laundry, and the boys wash their own clothes. It is the *chef d'atelier* who adjudges the little rewards in money which are given to the best workmen among the *colons* at the close of every three months, to the amount of about  $3\frac{1}{2}f.$  for the best, with a graduated scale down to the 8th, if the family consists of from forty to fifty boys, but only down to the 4th, if it consists of from twenty to thirty.



The *chef de famille*, however, puts his veto upon the reward if the conduct of the child in the family has not been satisfactory. Whatever the reward may be, it is always doubled if the recipient is in the position of a *frère aîné*. Part of the money is put into the savings' bank at Tours, and, I believe, one-fourth is at the disposal of the child, at the discretion of the *chef*, but the account books are entirely in the hands of the controller of the finances of the establishment. A boy in receipt of any money has to make payment for any part of his dress which requires to be renewed before the stated time arrives at which fresh clothing is given out, which otherwise is all furnished by the institution. On the other hand, if his clothes are found in good condition at such time, he receives the benefit of it by having the money which would have been laid out in clothes placed to his account. The dress is uniform and extremely simple, and just what would be worn by the boys if working at home—viz. : a plain brown blouse or short tunic, canvas trousers, *sabots*, and straw hat. The money in the bank is paid to the boy on his leaving Mettray, unless, by his desire, it is allowed to remain yet longer. The boys wash in open sheds, attached to the various houses, and connecting them at the back. There is a large fountain at hand, from which they carry the water in large tubs to the sheds. Twice a week they are taken in divisions to a reservoir to bathe and learn to swim in summer.

The strictest discipline is observed, and nothing is overlooked. Dry bread is an occasional punishment, but the cell is a more frequent one. Every fault which has called for reproof is registered, and a most careful and detailed conduct book is kept, showing the behavior of every child. Here are seen at a glance his name, previous residence, habits, health, appearance in detail, the crime for which he was convicted, every possible information which can be gleaned with regard to himself and his family, with a most careful and complete report of his behavior since admission. When a fault calls for punishment, before it is inflicted upon the child, he is made to retire into the cell which takes for the time being the name of *Salle de Reflexion*; he is kept there for an hour or so, and meanwhile the *directeur* reviews his conduct book, takes into careful consideration the previous circumstances and conduct of the boy, his general character, his advantages and disadvantages, and, having carefully weighed them, and taken time to collect himself, and give the boy leisure to reflect upon his fault, he is in a position to pronounce, as far as human discernment goes, the exact measure of punishment deserved by the child. Those confined to cells have an hour's exercise a day in chopping wood, or in some similar occupation. The cells are bare rooms, with sufficient light and air for health. Punishment is administered for apparently trifling faults. We found four boys in four cells on the occasion of our visit. One was there for refusing to sing the day before, two for taking chestnuts, and the other for being found near the cellar, where he had no business to be. I think it will be allowed that these are not offenses of a very grave nature, and, as the discipline is so strict, that it is satisfactory, there were so few boys from a larger number. The cells are so placed and arranged that those in them, although unseen, can be admitted to take part in the church service, at the back of the altar of the church, on Sundays. Eight Sisters of Charity undertake the housekeeping of the establishment; an account of all that will be required of them on the coming day is handed in to them the evening before, by the controller of the finances.

There are six farms attached to the institution. The land consists altogether of 260 hectares, or about 520 English acres. The farming is overlooked by a very gentlemanlike person in the pay of M. Demetz. The land appears well cultivated, and a large stock of horses, cows, and pigs are kept. It must be an excellent thing, I think, for children to have the care and tending of dumb animals—'*Emollit mores, nec sinit esse feros.*' The farm buildings are as simple as possible—just such as the *colons* are likely to find themselves in in after-life. Each of these farms has a separate establishment with a separate kitchen,—there being but one kitchen for the principal stock of buildings which I have hitherto spoken of. To each farm is attached a *chef de famille* and a respectable farm laborer and his wife, who is housekeeper and cook. The boys employed on the farms only associate with the body of boys employed otherwise on Sundays and feast days, when they go up to enjoy their holidays together. They are employed to work hard, and to adhere altogether to agriculture; they sleep in hammocks like the rest, and sleep, eat, and learn in the same airy barn-like room. The walls in all the rooms are hung here and there with improving prints and engravings, the



subjects being for the most part religious or military. There is a large, rough, wooden and thatched open outhouse put up in a field, where the children are made to break stones in wintry, rainy weather. They do all their work by the piece, so as to excite and accustom each child to industry. The boys, moreover, are made to practice gymnastic exercises, and every thing they do, they seem to do heartily.

A ship has been put up—on dry ground, of course—for the boys to gain as much knowledge as they can of seamanship, and an old sailor is engaged to instruct them. Some of the boys, also, are formed into a fire-brigade, and have rendered at times substantial assistance in the neighborhood, and only the other day saved the village church of Mettray from destruction by fire. The children are taught singing, but only as a means to the grand ends; and in order not to give an opportunity for individuals to distinguish themselves, or for the creation of fine solos, they are very much taught to sing in parts, or at least only in masses; and if a boy shows any turn for drawing, he receives a little instruction in it, but only in linear drawing. Evasion is looked upon with much severity. If a boy has escaped, a flag is hoisted on the top of the church by day, and a lamp by night. A reward of from 30*f.* to 40*f.* is given to the person bringing the boy back. It is scarcely possible, without a personal visit to Mettray, to form a correct idea of the amount of study and attention which is devoted to the consideration of every particular, and of every child in particular. The family division makes this easy by concentrating the attention of the several *employés* allotted to the same number of children; if assembled in an undivided mass the same amount of good could never possibly be effected, for the attention of each one would be divided by the whole number; nor could the interest in each other be awakened which now exists between the *chef de famille* and his young people. As for the *employés* themselves, who are gentlemen by nature, if not always by birth, it is quite impossible to see and converse with these intelligent, well-educated, and benevolent men without feeling how great must be their elevating influence upon the character and general tone of the boys. The two principal *employés* are in receipt of 160*l.* per annum each. They are of a standard of intelligence and ability which would insure their advancement in any profession, and one feels their devotion to be the more admirable. M. Demetz has been very particular in placing his *employés* in a respectable and comfortable position, and has built for the two principal ones excellent houses a little apart from the houses for the boys. The wives of these two gentlemen are perfect ladies, and we had the pleasure of meeting them at dinner at M. Demetz's house.

There are many things at Mettray, suggested by the military spirit of the French, which would at first sight appear, perhaps, impossible to carry out in an English institution; but I see no reason why the feeling of 'honor,' which I believe to be as strong in an English child as in a French one, should not be appealed to with advantage in an English reformatory. Why should not we have the table of honor hung up where every one can see it, upon which is inscribed the name of every child whose conduct during the last three months has not called for punishment? With regard to the almost military discipline and order with which the children go through their movements before and after work or meals, I consider that by it a great saving of time is made, and five or ten minutes upon every change of movement are saved which would be otherwise lost in collecting and adjuring stragglers, both young and old.

Let me mention and recommend, too, the box placed within general reach, *pour les objets trouvés*, which is a delicate way of allowing a boy whose temptations have been stronger than his virtue to listen to the reproaches of his conscience, and, without being publicly brought to shame, to restore the theft which lies heavy on his soul.

I will say no more of Mettray at present, except that the instruction given is firmly based upon religion, and includes reading, writing, and arithmetic, but very little beyond it.

Lesson hours do not exceed one or two hours a day. I must add that the children are first received as innocent, and as having sinned without discernment, and therefore irresponsible for their actions; but when they have been once admitted to the benefit of the instructions given them in the institution they are considered to be capable of discernment, and become subject to the strict rules observed in the institution."



To the foregoing account of the System of Agricultural Instruction in France as organized in 1848, and as we found it substantially in operation in 1852, we add a more extended notice of its historical development at present (1869), abridged from a special report by M. Pompé in behalf of the Jury on Agricultural Education at the Paris Universal Exposition in 1867, and other official documents and programmes.

#### HISTORICAL DEVELOPMENT.

In the year 1793 the celebrated Thouin founded in the *Jardin des Plantes* at Paris, a course of vegetable physiology applied to culture, which course has been continued up to the present day. Even earlier, in 1785, the illustrious Daubenton established at the veterinary school at Alfort, a course of agriculture and rural economy, which has likewise been continued.

When the First Consul reorganized public instruction in 1801-3, this branch was not forgotten, but Foureroy, in a speech before the legislative body, April 20, 1802, gave the reasons for its not being recognized in the organization of special schools. He said: "Agriculture, where methods are only perpetuated by tradition, which is slowly but surely developed by example and experience, has not been introduced into our special schools, because these schools are frequented by those who do not till the ground, and because those who work in the fields will not follow the rules laid down, or will follow them blindly without a thorough understanding of the principles on which they are founded. It is the duty of the landed proprietors to teach this great art practically on their own estates, and of the agricultural societies to make known good practices in their respective departments. Besides, the principles of the natural sciences which are applicable to all the branches of rural economy, will be taught in a sufficiently large number of establishments to enable all who desire progress of agriculture to obtain the requisite knowledge in the lycea and special schools."

In the Conservatoire of Arts, established in 1782, a collection of agricultural implements was begun at an early day; and much later, by a royal decree of August 25, 1836, three new professorships were created, viz: one of general principles of agriculture, one of agricultural mechanics, and one of agricultural chemistry—comprising lectures on the proper preparation of the ground, draining, the implements of husbandry, irrigation, construction of embankments, rural buildings, the raising of cattle, the different kinds of soil and their adaptation to different crops, the cultivation of vegetables, and the laying out of arable grounds into larger or smaller portions to obtain a certain rotation of crops.

In addition to these lectures at the capital, the head gardiner of the Luxembourg every spring delivers a course of lectures on grafting, which are always well attended, and M. Isidore Geoffroy Saint-Hilaire has introduced into the zoological instruction of the Museum of Natural History a course on the acclimatization and domestication of animals. Other cities have followed the example of Paris, and Quimper, Bordeaux, Rodez, Toulonse, and Nantes, have established professorships of agriculture.

The courses of lectures at Rouen, (M. Pouillet on *agriculture*, Dubreuiel on *arboriculture*, Girardin on *chemistry*,) have justly become celebrated. At Besençon Dr. Bonnet did not remain satisfied with lecturing, but led his hearers into the fields, there practically to demonstrate his theories, describe the new imple-

ments, and show their management. At Compiègne M. Gossin has, by his example and his writings, powerfully contributed to the introduction into the humblest schools, the study of agriculture, and by an occasional exhibition of the products of the pupils of these schools, demonstrated the capability of this new instrumentality for diffusing agricultural knowledge.

But agriculture cannot be taught in schools and from books alone; the practice must necessarily be joined to the theory,—the eye and the hand must come to the aid of the intellect, and new habits must be formed. This was universally felt and acknowledged by all those who were called on to combat rural prejudices and introduce better methods of culture.

But to attain this end peace was necessary; but for a period of twenty-five years the whole of Europe had been trampled by the march of armies, and its best fields had been the theatre of mighty conflicts. The ravages consequent thereupon, the excessive expenses necessary to the maintenance and movement of the immense armies and the withdrawal of men, did not allow of the introduction of improved processes, which required but time and intelligence, men and money. Germany, it is true, in spite of the continental war, had already laid the foundation of agricultural instruction in some special establishments, when in the year 1818 one of the most esteemed and renowned agriculturists of Lorraine, M. Mathieu de Dombasle projected the establishment of a model farm (*ferme exemplaire*), as it was then called, in order to spread among farmers a knowledge of improved practice, and contribute thereby towards the reform of our agriculture. For two years M. Dombasle made vain attempts to obtain from government the coöperation which he required. Unfortunately the whole attention and all the resources of the government were concentrated on the manufacturing industry; but the viscount of Villeneuve, prefect of la Meurthe, comprehended the great importance of the project. Under his active exertions a subscription was opened among the rich landed proprietors of the department, and the duke of Angoulême was induced to place his name at the head of the list.

This model farm was opened in 1822, on the domain of Roville. Then commenced for M. Matthieu de Dombasle a combat which lasted for thirteen years. With his own resources and the small sum which the associative spirit, then in its infancy, placed at his disposal, completely abandoned by the government, this pioneer fought in succession against the barrenness of the soil at Roville, the insufficiency of his funds, the fall in the price of produce, the failure of the distillery which he had established, the murrain (*epizootic*) which visited the stables of his farm, and the revolution of 1830, which withdrew his pupils, suspended the sale of his manufactured implements. These conditions would have discouraged a less persevering character than M. de Dombasle, but he was not to be overcome. With calmness and firmness he pursued his object, until finally the government, satisfied of the services rendered to the cause of improved agriculture by the establishment at Roville, determined to assist his efforts. February 14, 1831, a subsidy of 3,000 francs was accorded to him, and soon after a large order for agricultural implements given by the government, brought new activity into the workshops and new resources into the treasury of the establishment. During the following year the farm obtained special grants which finally were converted into a fixed fund of 3,000 francs, destined to furnish stipends for ten students who were themselves not able to pay. Later, on the application of M. de Dombasle, these 3,000 francs were applied to the direct payment of the professors of the institution, whose teaching thus became gratuitous.



In spite of the insufficiency of this assistance, in spite of the difficulties of the location against which M. de Dombasle had to fight incessantly, he succeeded in maintaining the institution till the year 1842, the year which brought to an end the onerous lease, the hard conditions of which had created so many difficulties. M. de Dombasle then sorrowfully resolved to abandon this ungrateful domain on which during twenty years of incessant activity he had completely exhausted his bodily and mental strength.

Thus ended this celebrated school at Roville, at which the noble founder spent his energy, his health, and his fortune. In spite of its many imperfections and its short-lived existence, it will always be honorably mentioned as the first example in France of an institution exclusively devoted to the perfecting and study of practical agriculture. By its influence it contributed powerfully to awake in France a taste for agricultural studies and to spread among the landed proprietors the demonstration that there still remained many reforms and improvements to introduce into the cultivation of their property. France, which must be reproached with not having aided him sufficiently, to-day reaps the fruit of his long sacrifices.

The impulse given by M. de Dombasle and the reputation of his school soon awakened imitators and led to the establishment of similar institutions. The first in time as in importance, was the royal agronomic institution at Grignon. It was founded in the year 1827, but in its inception and organization, it was made clear that the work and the example of M. de Dombasle had borne fruit, and that people began to understand better the interest which agriculture has a right to claim. Everything that had been wanting with M. de Dombasle, soil, capital, patronage, was united in favor of Grignon. In the place of a sterile domain of 150 hectares (1 hectare = 2.47 acres), in a distant province and leased on onerous conditions, a royal glebe of nearly 500 hectares, almost at the gates of Paris, was virtually given away by the monarch at a merely nominal rent, and even that rent itself payable only in improvements, the benefits of which the founding society should reap during the forty years of its possession. Instead of the paltry sum of 45,000 francs, collected with a great deal of trouble, to constitute a fund for the carrying on of Roville, the capital of Grignon was by an act of the society fixed at 600,000 francs, half of which sum could be realized in two years and one month.

After having been in existence ten years, in spite of the organization of a public school of agriculture, in spite of the establishment of a factory of first-class agricultural implements, in spite of the publication of the "*Annales de Roville*," a periodical which by its scientific depth and its practical usefulness vied with the most celebrated publications of this kind in Germany, the institution at Roville was left to its own resources, and received no subsidies from the State.

Grignon, more fortunate, had not yet attained to the second term of its existence, when it was aided by an annual subsidy, which amply provided for all the expenses and wants of its school, and procured for it at the expense of the public treasury, a number of pupils, on which the institution could always count. By the terms of the statutes of the society, the founders of Grignon had proposed to themselves a two-fold aim: 1, the cultivation of the domain according to the most approved methods indicated by the practice of the most advanced cultivators, especially of Germany; 2, the establishment of two schools, one designed for the teaching of mathematics, physics, chemistry, botany, veterinary surgery, &c., the other intended to educate farmers theoretically and practically. The latter was never organized, and the former was only commenced in the year 1832.



If Grignon could create and maintain its school, if in consequence it could contribute to the progress and improvement of agriculture by the useful knowledge which its director and some of its professors were spreading by periodical publications, and by the pupils which it educated, it must be remembered that this was due to the help it received from the State; we must also remember, after the example of Roville and other institutions of which we shall speak, that it is impossible to organize a lasting and complete instruction in agriculture without government aid, with only the resources of individual or associated zeal, and without finding a man uniting sufficient capital with the most eminent mental qualifications.

On leaving Roville in 1830, M. Rieffel had gone to Bretagne; the third part of this vast peninsula was then covered by moors (*landes*) and heath, and was uncultivated and unproductive. The remaining two-thirds were far from yielding the produce which with a better system of cultivation it was capable. Wretched cattle, miserable pasture, imperfect agricultural implements, irrigation unknown, the woods perishing, all these combined seemed to solicit improvements and promise a fortune to him who would introduce them. Under these circumstances, M. Rieffel, the scholar of M. de Dombasle, undertook the work of cultivating these millions of hectares, and immediately, with the confidence and courage of youth, went to work on a domain called "*les landes de Grandjouan*" (Department de Loire-Inférieure), situated between Rennes and Nantes, and comprising 500 hectares, of which four-fifths were fallow ground. As he had no capital to buy and cultivate this land, he in connection with several others, formed a society, which furnished him with funds, and whose duration was fixed at twenty years. Every year the public gained more confidence as the country passed from a state of sterility to one of productiveness. Already since 1833 the General Council of his Department lent their aid in order to found on the lands of the farm a primary school of agriculture, destined for poor young peasants. A subsidy of 5,000 francs was at first granted him on the condition that he would take charge of twenty poor scholars between the ages of fifteen and eighteen, give them primary instruction and accustom them to agricultural pursuits. The government soon added a still larger donation to that of the departmental authorities.

These subsidies, continued from year to year, furnished M. Rieffel with the means of sustaining and developing his work. He cleared the ground on his entire domain, and following the example of M. de Dombasle, added to the primary school a school of agriculture and a factory for agricultural implements. He published amongst the rest, under the title of *Agriculture of the West*, one of the most interesting agricultural journals that has ever appeared. And although there were men who contested the usefulness of his work, the General Council of the Department at various times accorded to him the tribute of their approbation and encouragement. In spite of these successes, the school developed but slowly, the number of pupils was limited, the necessary apparatus was wanting, and the insufficient resources did not allow the founder to effect improvements, the necessity of which no one felt more keenly than he himself.

At this juncture M. Rieffel applied to the government to convert his establishment into a district or regional institution (*institut régional*). The minister of agriculture, who fully appreciated the influence which the school at Grandjouan could exercise on a province which stood so much in need of it as Bretagne, gave this application a favorable consideration, and by a decree of March 9, 1842,



the institution was reorganized. In consequence of this measure the number of pupils increased and reached during the following years an average of twenty-six. Since then, the charge was in 1844 raised to 700 francs. In 1846 the salary of the professors was likewise raised, and a selection from the government stables was made for the institution in order to improve the breed of horses. These dispositions which so loudly testified to the generous intentions of the government to favor as much as possible agricultural instruction and to give to the institution of Grandjouan the means of developing and making itself useful, did not altogether accomplish the desired effect. In consequence of financial embarrassments which the director met with, and particularly in consequence of the disturbances of 1848, the existence of the institution was seriously menaced. Fortunately the new government, in proposing the law of September, 1848, regarding the organization of agricultural instruction, saved the fruits of sacrifices previously made by the state. The establishment was changed into a provincial school (*école régionale*), an official position which it holds to this day.

The establishments thus far spoken of have for their object secondary agricultural instruction, that is to say, instruction which ought to prepare intelligent landed proprietors, farmers, and capable administrators, the chiefs and officers of this great interest. As regards the subordinate officers and soldiers of this toiling and peaceful army, that is to say, the small cultivators and master-farmhands, they could prepare themselves on the domains attached to these institutions, the cultivation of which required a numerous and able corps of workmen. Some of these establishments had even thought of regulating the recruiting of this force, and to prepare it beforehand by attaching to their farm a school for the sons of poor peasants, or orphans, who should be trained for agricultural work, and who should propagate the good practices acquired at school, by being placed with the landed proprietors and farmers of the land. This plan was fully realized at Grandjouan, where it continues to exist. Only it was transformed into a farm school (*ferme-école*), since the change of the whole establishment to a provincial school (*école régionale*).

All that had hitherto been done was not sufficient. Other attempts, more or less fortunate, to establish farm schools, had been made in various departments outside of the large institutions, under the name of "rural asylums," "agricultural colonies," penitentiaries for receiving and educating abandoned children and orphans. Others, under the name of "school-farms" or "model-farms," "schools of agriculture," received adults with the object of training them for work in the fields and educating them for agricultural workingmen who might be at the disposal of the landed proprietors and farmers.

The zeal and devotedness of wealthy private individuals, charitable associations, and agricultural societies, raised in a few years a certain number of these asylums, model-farms, and school-farms. The administration favored this tendency by encouragements and subsidies. These first attempts, however, as might have been expected, met with difficulties and hindrances in administration and intelligence, which will be found whenever anything new is started. But the government, which by its subsidies maintained the greater part of these establishments, neglected no opportunity to remedy any imperfections or abuses that might creep in. It called to its aid the General Council of Agriculture, and in 1845 charged it with the question of agricultural instruction. A committee was appointed by the council and chose for its president M. Turret. This committee received from the minister all the documents which could throw light on the



subject, and especially the constitutive acts of all the establishments already existing.

The General Council, after a lengthy discussion, adopted the basis on which the administration had commenced to build up agricultural instruction, admitted the school-farms as the first degree of instruction, and the institutes as a sort of secondary school of agriculture. Besides, in order to complete the system, it demanded the creation in the environs of Paris of a superior institution destined to favor the tendency of science to occupy itself with agriculture, and which, under the name of "experimental farm," should be especially devoted to scientific experiments.

In consequence of this coöperation of the great majority of the agricultural representation, the administration, though somewhat limited in its enterprises by the small funds placed at its disposal, advanced with more firmness on the road which it had once entered, and attempted to constitute the institutes and school-farms on the basis approved of by the general council, and to increase their number. Starting in 1846 it subjected them to certain conditions having for their object to bring these establishments under a regular and uniform organization. The government took upon itself the expenses of teaching, leaving to the proprietor or farmer the care and responsibility of directing the school. The course of instruction was rigorously limited to the wants of that class of cultivators which needed the education, and adapted to the special wants of the different localities.

A small number of old school-farms had been able to maintain themselves. In 1847 there were only nine. In that same year the administration founded ten new ones. In January, 1848, two more were opened. Four more were being organized when the February revolution broke out. At that time, therefore, there existed in France twenty-five school-farms, and the two institutions at Grignon and Grandjouan.

Such was in brief, at the same period, the organization of agricultural instruction in France, and this organization was not the result of a suddenly improvised plan, but the expression of public wishes, the fruit of experience and time, the natural and necessary results of accomplished facts.

If we examine this first phase of agricultural instruction in France, we are painfully struck by seeing the majority of these institutions succumb to difficulties which assailed them at their very outset. But in this respect it shares the fate of all human institutions, which have to make their debut under novel conditions, and have to pass through the transformation of progress. The pioneers will exhaust their strength in clearing the way, whilst those who follow find the way open and reap the fruits of the labors of men who worked before them. Very rarely will he who thus opens the way arrive at the end; thus the history of discoveries, improvements, and progress, is but too often nothing else but a recital of the tribulations and ruin of men to whom mankind is largely indebted.

Touret, the old chairman of the agricultural committee, after having been made minister of agriculture and commerce, proposed to the National Assembly in the session of July 17, 1848, a project for organizing agricultural instruction. M. Richard (from Cantal), August 21st, in the name of the committee for agriculture, presented an important report on this subject, and after a remarkable and interesting discussion, the decree, only slightly modified, was adopted October 3, by 579 votes out of 679 voting members. There were thus still 100 votes against a project of incontestible usefulness.



This is not the place to analyze this decree, which regulated agricultural instruction in France. We will limit ourselves to calling to mind, that by endeavoring to improve them it maintained the existence of the school-farms where a practical elementary instruction was given, that it completely reorganized the institutions, which had been converted into provincial schools (*écoles régionales*), and that it established over all these institutions a school of a superior kind, called the Agronomic Institute, which was to be the superior normal school of agriculture.

This organization completed that which existed in a manner to satisfy the wants of all classes of society; it offered to all and every one the kind of instruction which suited his individual tastes and wants.

#### CONDITION OF AGRICULTURAL EDUCATION IN 1869.

##### *Model-Farms.*

In the model-farms the apprentice or scholar is practiced in the use and handling of agricultural implements, to execute with his own arms agricultural operations, to care for and nurse with his own hands the domestic animals. Some short and simple explanations given by the professor or director, teach him why one instrument is preferable to another, why certain operations ought to be made in such and such a manner and in no other, why the care bestowed on the cattle must be of such and such a nature. These explanations always follow the very operation which they are to illustrate.

The business of the farm is carried on entirely at the risk of the proprietor or farmer of the domain, who is the director of the establishment. The State defrays the charge for boarding and lodging the apprentices, an amount which, together with their work, is given to the director to indemnify him for the expenses he incurs for them. The expense of instruction is also borne by the State, which consist of the salaries of the director and of such teachers as may be employed. The term of apprenticeship is three years, and on entering and leaving, the pupils are subjected to examinations; premiums are granted to the ablest and most meritorious. There are altogether 48 of these school-farms, with about 1,300 apprentices distributed among them. The apprentices on leaving the school very soon find profitable situations, which shows that their good results are appreciated by the rural population.

##### *Regional Schools.*

In the practice or apprenticeship of agricultural students, these two kinds of instruction are united in the provincial schools (*écoles régionales*), where the pupils receive theoretical lessons methodically, with explanations and proofs, all the while executing with their hands the various agricultural operations. This is a mixed instruction, where the alliance of theory with practice prepares the lower officers of this grand army of tillers of the soil (*grande armée des cultivateurs*).

These schools are under the direction of a steward (*regisseur*), who is charged with the cultivation and administration of the domain for the account of the State. At the side of the director, and under his authority, are placed the teachers. The pupils, who are all boarded in the institution, are admitted after a competitive examination. The course extends over three years, and on leaving, the pupil is examined and receives a certificate of proficiency. The State pays for eighteen scholars in each school.



## REGIONAL AGRICULTURAL SCHOOL AT GRIGNON.

The agricultural school at Grignon was founded in 1827 by M. Bella, as the executive officer and director of the school, in behalf of a society formed for the purpose of improving the agriculture in that district of France. The domain consists of about 1,170 acres, and is situated twenty-five miles west of Paris, ten miles from Versailles and the markets of Passy and St. Germain, and sixteen miles north of Rambouillet and Videville, the great government sheepfolds of France. It became the property of the crown, and in 1827, Charles X granted it on a lease of forty years to the Agricultural Society of Grignon, on the following conditions:—1. To apply and perfect an instructive system of agriculture on the domain; 2. To organize a scientific and practical course of instruction in agriculture; 3. To make all necessary local and needed repairs on the building; 4. To make permanent improvements on the estate to the value of 300,000 francs, such as buildings, roads, plantations, etc.; 5. To make general improvements to the lands in addition to the sum named; 6. To preserve and renovate the forests on the place. These improvements, to the annual cost of about \$1,500, were to be made in lieu of rent. The management of the domain and of the school was inaugurated with a view of realizing profit on the investment made by the subscribers; but the result soon showed that the department of instruction was curtailed in its professorships and equipment in order to secure more profitable returns from the farm. It was found necessary for the government in 1848 to take the school under its entire charge, giving it the title of the Imperial School of Agriculture, leaving the management of the estate in the hands of the Society, the director of the whole being elected by the council of the Society and confirmed by the Minister of Agriculture.

The term of residence at Grignon is fixed at two years; but the pupil remains three months after his studies are completed, in order to digest and draw up the entire management of an estate, and describe its details in every department.

The students are divided into classes denominated internals and externals, or resident and non-resident. The former reside entirely in the house, where they are lodged and boarded, and pay about 800 francs, or 32 pounds, or 160 dollars, per year. The externals, or non-residents, provide for themselves, or lodge at the houses of the neighboring farmers, and pay a very small amount for their instruction. This arrangement is particularly designed to benefit poor scholars. Both classes are equally subject to the general discipline and rules of the institution; and are alike engaged in the same works and studies.

There are lectures every day in the week. At the commencement of each lecture, the professor examines the pupils on the subject of the preceding lecture; and they are required often to take notes, and present a written report of the lecture. Besides the professors, there are two monitors, who have been educated at the school, who labor with the pupils in the fields. They are expected, and it is their duty, to question the pupils on the subjects which have been treated in the lectures; to show their application; to illustrate what may have been obscure; and, in short, to leave nothing unexplained which is liable to misunderstanding or error. There are two public examinations annually, in which the scholars are subjected to a rigorous questioning in what they have been taught. If, at the end of two years, their conduct has been approved, and their examination is met successfully, they receive a diploma from the institution.

They are not only employed in the general work of the farm, but particular portions of land are assigned to individuals, which they manage as they please, and cultivate with their own hands; they pay the rent and expenses of manure and team, and receive the product or its value from the institution. Certain of them are appointed in turn to take care of the different departments of the farm for a length of time—such as the hog establishment, the sheep establishment, the cattle, the horses, the implements, &c. &c. They have likewise adopted a practice, which seems much to be commended—that of employing workmen,



shepherds, cow-herds, &c., from foreign countries; as, for example, from Belgium and Switzerland, that they may in this way become acquainted with the best practices in those countries.

The time is thus divided and arranged among them:—they rise at four o'clock in summer, and at half-past four in winter. They go immediately into the stables to assist in the feeding, cleaning, and harnessing of the teams, and the general care of the live stock, according to their respective assignments. At half-past five they take a light breakfast; at six o'clock they go into the halls of study, and here they remain until eleven o'clock; at half-past six they attend a lecture, or course of instruction, which occupies them until eight o'clock; at half-past eight they are occupied in reading or in making notes of the lectures which they have heard, and the monitors before spoken of are present to render them any assistance required; at half-past nine o'clock there is another lecture or course of instruction for both sections, which occupies them until eleven, when they take their second or principal breakfast. From noon until five o'clock, the pupils are occupied in labor or practical operations. The professors, from time to time, take a section, and employ them in land-surveying, in drawing plans, and in levelings; others are occupied in mineralogical or in botanical excursions, or in inspecting the management of forest lands; others are occupied by their teacher in the practical management of farming implements, in the management of teams in the field, in sowing, and other general operations of husbandry, in a field devoted to these purposes; and a section, to the number of twelve, are every day employed in the direct labors of the farm, in ploughing, digging, harrowing, &c. &c. They work in company with the best laborers, that they may observe and learn their modes of executing their work. They are required to be attentive to every operation that is performed; and to present a full report of each day's work to the director-general.

At half-past five in winter, and at six in summer, they take their dinner. At seven o'clock in the evening they go again into the halls of study. From seven to half-past eight o'clock there is another course of instruction, or a repetition of what they have had before. Until nine o'clock they are occupied in their journals, or in making notes of their lectures. At nine o'clock the sleeping rooms are lighted, and they retire for the night.

There are several distinct professorships. The Professor of Practical Agriculture gives two courses; the one written, the other oral; and, like the lecture of a clinical professor at the bed-side, it is given in the fields. This professor understands not only how a thing should be done, but how to do it; and he can put his hand to every form of agricultural labor, such as ploughing, harrowing, sowing, managing the teams, feeding the animals, handling every instrument of agriculture, buying, selling, &c. In the words of his commission, his object is at the same time to form the eye and the hand; to teach his pupil how to learn; to command, to direct, and to execute. To this end it was necessary to form a complete agricultural organization for practice, independent of the exercises attached to the departments of the other professors.

The farm is composed of

Arable land, about . . . . .	670 acres.
Land in wood and plantations . . . . .	365 “
Irrigated meadows . . . . .	35 “
Gardens, including vegetable, botanical, fruit garden, orchards, mulberry plantations, osiers, and nurseries . . . . .	28 “
Ponds and water-courses . . . . .	15 “
Roads and lands in pasture . . . . .	50 “
Occupied by buildings . . . . .	6 “

The animals on the farm include

Animals of draught or labor of different kinds . . . . .	18
Oxen for fattening . . . . .	20
Cows of different ages and races, and different crosses . . . . .	100
Sheep, embracing the different kinds . . . . .	1100
Swine establishment . . . . .	100



There are likewise on the establishment workshops or manufactories, if so they may be called,—

- For the making of agricultural instruments ;
- A threshing-house and machine for grain ;
- A dairy room for the manufacture of different kinds of cheese and of butter ;
- A magnanerie, or establishment for silk-worms ;
- A stercorary for the manufacture of compost manures.

To all these various departments the attention of the students is closely called, and they are required to take some part in the labors connected with them.

Besides the farm belonging to the establishment, there is a field of one hundred acres devoted exclusively to the pupils, and principally to the culture of plants not grown on the farm. Here they make experiments in different preparations of the soil, and with different manures.

Every week two scholars, one of the second and one of the first year, are appointed to attend particularly to the general condition of the farm. Their business is to examine constantly the whole establishment ; the works that are going on in every department ; to look after the woods and the plantations ; the gardens ; the horses ; the fattening cattle ; the dairy ; the sheep-fold ; the swine ; and the hospital ; and to attend to the correspondence, and the visitors. This service lasts a fortnight, and there is a change every week, taking care always that there shall be one scholar of the first, and one of the second year associated. They attend to all the labors on the farm, and to all the communications between the principal director and inspectors, and the laborers. In the veterinary or hospital department of the establishment, they assist the surgeon in all his visits and operations ; take notes of his prescriptions ; make up and attend to the administration of his medicines ; and observe particularly the sanitary condition of the stables and buildings, where the live stock, sick or well, are kept.

On Saturday evening, each scholar, to whom this duty has been assigned, makes to his fellow-pupils a full verbal report of what has been done. This report is transcribed into a journal designed for that purpose ; and thus a continued history of the entire management of the farm is kept up. The whole school is divided into sections or classes of twelve each : six of two and six of one year's standing ; and these sections are constantly under the direction of the Professor of Practical Agriculture.

As the establishment at Grignon may be considered a model agricultural establishment, it may be useful to go more into detail in regard to the course of instruction pursued here.

Once a week there is an exercise, which embraces every thing relating to the management of the teams and the implements.

First, for example, in the different modes of executing any work, and using the utensils employed. The harness, the collar, the traces, and how attached, the shaft-horse or the cattle attached to the load, and the adjustment of the load to their backs ; the yoke, the single yoke, the double yoke ; the pack-saddle ; the harnessing of a saddle-horse ; the team for ploughing ; the team for harrowing ; the team for drawing loads ; the team for wagons, and for carriages with all their appurtenances ; every one of these matters is to be practically understood, as well as the whole management of the team in action.

In ploughing, the turning the furrow, its inclination, its breadth and depths ; the laying out of fields ; the management of large and small fields ; how to make the first furrow, and finish the last furrow ; to lay the land flat, to break it up in clods ; to plough it at a certain angle, to lay the land in curved furrows : these are all considered, and make part of the instruction given. The preparation, equipment, and use of every agricultural implement—such as ploughs, harrows, rollers, scarifiers, cultivators, sowing machines, trenching machines ; the practice of sowing, the different modes of sowing, whether broadcast, by dibble, or in drills ; the application of manure both as to time, mode, quantity, and preparation, and the composting of manures, are matters of inquiry and practice.

The cutting of grasses ; the making of hay, and the construction of stacks ; the harvesting of grain, by the scythe or by the sickle ; appendages to the scythe, called commonly the cradle ; and the grinding of scythes ; the making of sheaves, and of shocks, or stacks ; and the loading and the stowing away of grain, are matters to be understood.



A practical attention is required to every form of service on the farm; in the cow-house; the horse-stables; the fattening-stalls; the sheep-fold; the styes; the poultry-yard; the threshing-floor; the stercorary; and the store-houses for the produce of the farm of every description. The duties in this case embrace not merely the observation of how these things are done, but the actual doing of them until an expertness is acquired.

Leaving the practical department we come now to the course of studies to be pursued.

For admission into the institution some previous education is demanded, and the candidate is subjected to an examination before the principal and one of the professors.

First, he is required to present an essay upon some subject assigned to him, that his knowledge of the French language and grammar may be ascertained.

It is necessary, next, that he should be well grounded in the four great rules of arithmetic; in fractions, vulgar and decimal; in the extraction of the roots; in the rules of proportion and progression; and in the system of measures adopted in France.

In geometry, he must be well acquainted with the general principles of straight lines and circles, and their various combinations; and with the general measurement of plane surfaces.

In natural philosophy, he must understand the general properties of bodies; and be acquainted with the uses of the barometer and thermometer.

Candidates for admission must bring with them certificates of good character and manners, and must be at least eighteen years old. They are rigidly held to an attendance upon all the courses of instruction at the institution; and have leave of absence only on the application of their parents or guardians.

The studies of the first year are begun with a course of mathematics. Geometry and trigonometry are made a particular subject of attention; embracing the study of straight lines, and circular or curved lines on the same plan; the admeasurement of surfaces; the use of the compass; the recording of measurements; the delineation of measurements; the surveying of open fields, of woods, of marshes, of ponds or lakes; comparison of ancient land measures with those in present use; the use of the square, the chain, and the compass; the elevation of plans; the construction of scales, and the ordinary divisions of landed properties.

The study of various plans in any form; solid measure; conic sections, their principal properties, and their practical application; the theory and practice of leveling; the method of projections and their application; cubic measure of different solids, of hewn stones, of rough stones; the measurement of loose or broken stones, of sand, of lands excavated, of ground filled in, of stacks, and of heaps of manure; the cubic measure of trees standing, and of felled trees, of beams, and every kind of carpenter's work, of firewood, of walls, arches, and ditches or dikes; the ascertaining of the capacity of carriages, wagons, carts, wheel-barrow, pails, troughs, barrels and casks, basins or ponds, and different vessels in use, and of granaries and barns, and the determination of the weights of bodies. To all this is added a full course of trigonometry. They are accustomed likewise to the familiar use of the scale, of the square, of the compass, and of the compasses for delineation, and are often occupied in superficial, and in profile drawing.

The next course of instruction embraces embankments, the force of earths and liquids, or their pressure, at rest or in motion.

The materials employed in masonry; their uses and application in building—embracing stones, bricks, lime, sand, mortars, cements, plaster; and all the various modes of building.

The laying of walls for foundations; the erection of walls; the supports requisite; and the construction of passages, inclosures, and arches; the different kinds of woods, their absolute and relative strength; their duration, and the modes of preserving them; every kind of carpenter's work; the construction of floors, staircases, scaffoldings, and exterior supports; the constructions of roofs, in timber, with thatch, rushes, shingles, tiles, slates, zinc, or bitumen; the paving of roads, the formation of barn-floors, with clay or composition of bituminous substances which form a hard and enduring surface, are subjects of inquiry.



Next comes instruction in the blacksmith's shop, in the use of the forge, and the other implements of the trade; and in the various applications of iron and steel, of copper, lead, and zinc.

They are instructed, likewise, in the manufacture and use of leather and cordage; and in the various details of painting and glazing. The prices or cost likewise of all these different processes, are, as far as practicable, ascertained; and the modes of estimating such work are explained.

The next course embraces the elements of natural philosophy; and this includes chemistry, geology, and mineralogy.

First, the general properties of bodies, their divisibility, elasticity, and porosity or absorbent powers; and the special influence of this last circumstance upon the character of an arable soil.

The following are all subjects of study; bodies in the mass; the weight of bodies; means of determining the density of bodies and their specific gravity; the physical properties of the air; of atmospheric pressure; and of the construction and use of the barometer.

The study of hydrostatics; the pressure of liquids in their reservoirs, and against dikes and embankments; hydraulics; capillary attraction; the use of siphons and pumps.

The study of heat in all its various phenomena. Its effects upon solid and liquid bodies, and the changes which it makes in their condition; the phenomena of fusion, ebullition, and evaporation; of vapors; of the hygrometer or measurer of moisture, and the utility of the instrument; the conducting powers of bodies; of metals in particular; of free or radiating heat; application of heat to furnaces or kilns; laws of cold applied to bodies; power of emitting and of absorbing cold; measure of heat; means of determining the mean temperature of any place; influence of heat and cold upon vegetation; means of preserving certain vegetables from frost; construction and use of the thermometer.

Meteorology. Explication of the phenomena of dew; of white frosts; of clouds; of rain; of snow; their various influences upon harvest, and the whole subject of climate.

Study of light. Progress of light in space; laws of its reflection; laws of its refraction; action of light upon vegetation. The subject of vision. The polarization of light; the explication of the rainbow, and other phenomena of light; the prism.

Study of electricity. Conductors of electricity; distribution of the electric fluid in nature; power of the electric rods or points; electricity developed by the contact of bodies; of galvanic piles; their construction and uses. Atmospheric electricity; its origin; the formation of thunder clouds; action of electricity upon vegetation; of lightning; of thunder; of hail.

Chemistry. Simple bodies; compound bodies; difference between combination and mixture; atomical attraction; cohesion; affinity; what is intended by chemical agents. Explanation of the chemical nomenclature, and of chemical terms.

The study of simple bodies. Of oxygen; its properties; its action upon vegetation, and upon animal life. Nitrogen, sulphur, chlorine, carbon, hydrogen; their action upon vegetable and animal substances; their uses in veterinary medicine, and their influence upon vegetation.

The study of compound substances. Chemistry as applied to air and water; their importance in agriculture; their influence upon the action and life of plants and animals; the acids,—the sulphuric, the nitric, the carbonic, the chloric; the alkalis,—lime, soda, potassium, ammonia; their application in various forms. The salts in chemistry, and their various applications and uses; their importance as constituent parts of the soil, or as improvements.

The subject of marls and of earths, and of various substances deemed favorable to vegetation. Under the direction of the Professor of Chemistry, the students are taught to make analyses of different soils and marls.

To this is added a course of Mineralogy and Geology. This embraces the general properties of minerals; the physical, chemical, and mechanical character of mineral substances the most common.

The study of the distinctive properties and situation of those mineral substances which are most extended over the globe, and which are the most in use; such,



especially, as the carbonate of lime; comprehending stones for building, for the making of roads and walls, lime-stones, marbles, sulphate of lime, or plaster of Paris; and all the variety of mineral substances ordinarily found, and of use in agriculture or the arts.

A course of Geology follows this, embracing all the leading features of the science, with a special reference to all substances or conditions of the soil connected with agricultural improvement.

In this case, the professor makes frequent excursions with the pupils, that they may become familiarly acquainted with the subjects treated of in the lectures, and see them in their proper localities; so that the great truths of geological science may be illustrated by direct and personal observation.

Next follows a course of instruction in horticulture, or gardening.

Of the soil; the surface and the subsoil, and practical considerations relative to their culture and products.

Of the climate; the temperature, the aspect and local condition of the land in reference to the products cultivated; the amelioration of the soil, and the substances to be used for that object, with the modes of their application.

The various horticultural operations, and implements employed; and manner in which they are to be executed. The employment of water in irrigation; modes of inclosing by ditches or walls; walls for the training of trees; trellises and palings; and of protections against the wind.

The different modes of multiplication; sowing, engrafting by cuttings and by layers, and practical illustrations of these different processes. The culture of seed-bearing or grain-producing plants; the choice of them; their planting and management; the harvesting and preservation of the crops.

Under this head comes the kitchen-garden, and the choice of the best esculent vegetables for consumption; the nursery, and the complete management of trees from their first planting; the fruit-garden, considered in all its details; and the flower-garden.

The general results of gardening; the employment of hand, or spade-labor; the care, preservation, and consumption of the products, and their sale. The gardens at Grignon are upon a scale sufficient to supply all practical demonstrations.

The next division embraces the botanical garden. Here the whole science of botany is treated in its principles, and their practical application. The study of vegetable organization, with a full account of the prevailing systems and nomenclature of botany, and the classification of plants. Vegetable physiology, in all its branches, and vegetable anatomy; comparison of plants in their native and cultivated states; influence of cultivation in developing and improving plants; the propagation of plants in their natural condition, or by artificial means; the subject of rotation, or change of crops.

The practical application of these botanical instructions; and especially in the examination of plants or vegetables which may be useful in an economical view.

The garden of the establishment embraces what is called a school of trees; a school of plants for economical and commercial purposes; and a school of plants for common use. These are all carefully classed and distinguished by their proper names. The pupils are accustomed to be led into the gardens by the professor, that his instructions may be fully exemplified and confirmed.

The next branch of science taught at the school is veterinary surgery and medicine. This embraces a course of anatomy and animal physiology. It comprehends a full description of all the animal organs; and demonstrations are given from subjects, destroyed or obtained for that purpose. The functions of the different organs are likewise described; the organs of digestion, respiration, circulation, and the organs connected with the continuance of the species.

Every part of the animal, external and internal, is shown, its name given, its uses explained; its situation in relation to the other organs; the good points, the faults or defects in an animal; the peculiarities of different races of animals, with the modes of discriminating among them.

The choice of animals intended for different services,—as in horses for example, whether for the saddle, the race, the chase, the carriage, the road, the wagon, or the plough. Next, the treatment of the diseases of animals; the medicines in use; their preparation, and the mode of applying or employing them.



The next subject of instruction embraces a complete system of keeping farm accounts and journals, with the various books and forms necessary to every department.

From this the pupil proceeds to what is called rural legislation, embracing an account of all the laws which affect agricultural property or concerns.

The civil rights and duties of a French citizen, and the constitution of France.

Property, movable or immovable, or, as denominated with us, personal and real; of the divisions of property; of its use and its obligations.

Of commons; of laws relating to forests; of the rights of fishing in rivers; and of hunting.

The laws relating to rural police; to public health; to public security; to contagious or epidemic diseases.

The rights of passage of men or animals over the land of another; if any, and what.

Of crimes. Theft in the fields; breaking or destruction of the instruments of agriculture; throwing open inclosures; destruction or removal of bounds. Laying waste the crops by walking over them; inundation of fields by the stoppage of streams, or the erection of mills. Injury or breaking of public roads and bridges. Poisoning, killing, or wounding animals.

The duties of country magistrates; guards or justices of the peace. Of courts of law.

Of contracts, general and specific. Contracts of sale and prohibitory conditions. Of leases of different sorts. Of hiring labor; of the obligations of masters and servants. Of corporations, and the laws applicable to agricultural associations.

Of deeds, mortgages, bills of exchange, commissions, and powers of agency and attorney; insurance against fire, hail, and other hazards. Of the proof of obligations; written proof; oral testimony; presumptive evidence; of oaths. Of legal proceedings; of the seizure of property real or personal, and of bail.

The instruction proceeds under various courses, and I have so far given but a limited account of its comprehensiveness, and the variety of subjects which it embraces.

The study of the different kinds of soil, and of manures, with all their applications, and the improvements aimed at, take in a wide field. Under the head of soils there are the argillaceous, the calcareous, the siliceous, turf-lands, heath-lands, volcanic soils, the various sub-soils, loam, and humus.

Under the head of manures, come the excrements of animals, all fœcal matter, poudrette, urine; the excrements of fowls; guano; noir animalisée; the refuse of sugar refineries; the relics of animals; oil-cakes; the refuse of maltings; tanners' bark; bones, hair, and horn; aquatic plants; green-dressings.

The application likewise of sand, clay, marl, lime, plaster, wood-ashes, turf-ashes, soot, salt; the waste of various manufactures; mud and street dirt.

The plants cultivated for bread; wheat, rye, barley, oats, buck-wheat, millet, rice, and the modes of cultivating them.

For forage,—potatoes, beets, turnips, ruta-bagas, carrots, artichokes, parsnips, beans, cabbage.

Lucerne, lupins, sainfoin, common clover, trifolium incarnatum, vetches, peas, lentils, and plants for natural meadows and for pasturage.

To these are added, cobra, rape, poppy, mustard white and black, hemp, flax, cotton, madder, saffron, woad, hops, tobacco, chicory, teasles.

The weeds prejudicial to agriculture, and the insects which attack the plant while growing, or in the granary or barn.

The production of milk; and, as already said, the making of butter and cheese.

The production of wool; tests of its fineness; classing of wools; shearing of sheep; weight of the fleece; washing of wool before or after shearing; and every particular in reference to the subject.

The fattening of beef, mutton, and pork. Choice of animals for this purpose; nutritive properties of different kinds of food; in what form to be given; grains entire or ground; roots cooked or raw, green or dry; the value of the pulp of beet-root after the sugar is expressed; refuse of the starch factories; of the distillery; of the brewery; fattening by pasture or in stalls; comparison of the live weight with that of the animal when slaughtered.

Care and management of the various kinds of domestic poultry.



Care and management of bees, with the construction of hives.

Care of silk-worms, and their entire management.

All these studies are pursued in the first year of the course; and the time is so arranged as to afford the diligent pupil an opportunity of meeting his duties, though the period is obviously too limited for the course prescribed.

The second year enjoins the continuance and enlargement of these important studies; the higher branches of mathematics and natural philosophy; an extended knowledge of chemistry; and a thorough acquaintance with mechanics, when the scholars with their professor visit some of the principal machine-shops and factories in Paris, or its environs, in order to become practically acquainted with them.

The students are further instructed in the construction of farm-buildings of every description; in irrigation, in all its forms; in the drainage of lands; in the construction of roads; in every thing relating to farm implements; and in the construction of mills and presses.

As I have said, organic chemistry is largely pursued with the various manufactures to which it is applicable; and animal physiology and comparative anatomy are very fully taught.

These studies are followed by a course of what is called agricultural technology. This embraces the manufacture, if so it may be called, of lime, of cement, of bricks; the preparations of plaster; the making of coal by various processes; the making of starch; the making and purification of vegetable oils; the making of wines, of vinegar, of beer, of alcohol, of sugar from the beet-root, including all the improvements which have been introduced into this branch of manufacture; and the pupils, under the direction of the professor, are taken to see the various manufactories of these articles, so far as they are accessible in the vicinity.

The whole subject of forests, of nurseries, of fruit trees, ornamental trees, trees for fuel, trees for mechanical purposes, are brought under the student's notice. This is a great subject in France, where wood has an extraordinary value; where immense extents of ground are devoted solely to the cultivation of trees; and where consequently it is most desirable to understand the proper kinds of wood to be selected for the purpose in view; the proper mode of forwarding the growth of the trees; and of removing them without prejudice to their restoration. Under this head comes the culture of

Trees for fuel.

Trees for timber.

Trees for house and ship building.

Trees for fruit, including all the varieties adapted to a particular climate.

Trees for their oily matter; such as olives.

Trees for their bark; to be used in tanning, and other purposes.

Trees for their resinous properties; such as pines.

Osiers and willows for making baskets.

Mulberry-trees for the support of silk-worms.

Next to this comes the culture of vines, and the establishment and care of a vineyard—a subject of great importance in France.

I have already spoken of the veterinary course of instruction. This embraces the whole subject of the breeding and rearing of animals; their training, shoeing, and harnessing, and entire management.

Under the head of farm accounts, the establishment itself at Grignon is made an example; the accounts of which are kept most accurately by some of the students, and open to the inspection of all.

A journal of every thing which is done upon the farm is made up every night; and these accounts are fairly transferred into a large-book.

To this is added, a particular account of the labors performed, and the occupation of each workman on the farm.

Next, a cash-book, embracing payment and sales, which are adjusted every fortnight.

Next, an account with the house; charging every article supplied or consumed.

Next, a specific account of each principal department of the farm; such as the dairy, with all its expenses and returns; the pork-establishment; the granary, &c.; which are all balanced every month, so that the exact condition of the department may be known.



## AGRICULTURAL SCHOOL AT GRAND JOUAN.

THE Agricultural school at Grand Jouan, in Brittany, was established in 1833, by M. Nevriere, who had been trained in this department of education in the Roville Agricultural school. In 1848 it was remodeled by the government and placed under the administration of the minister of agriculture.

## SUBJECTS OF STUDY AND LECTURES.

*Mathematical Sciences*:—Arithmetic, Algebra, Geometry, Mechanics, Surveying, Leveling, Stereometry, (measuring solid bodies,) Linear Drawing.

*Physical and Natural Sciences*:—Physics, Meteorology, Mineral Chemistry, Mineralogy, Geology, Botany.

*Technological Sciences*:—Organic Chemistry, or Agricultural Technology, Agriculture, Arboriculture, Sylviculture, Veterinary Art, Agricultural Zoology, Equitation.

*Noological Sciences*:—Rural Architecture, Forest Economy, Rural or Farm Accounts, Rural Economy, Rural Law.

## ABSTRACT OF THE COURSE OF LECTURES ON GENERAL AGRICULTURE.

*Agricultural Formation, (Terrain,)*—1. *Soil*:—Constituent Elements, Classification of the Formation: Argillaceous, Siliceous, and peaty soils: Physical properties: Causes which modify these properties: Influence of soil on vegetation.

2. *Sub Soil*:—Sub soil active: Sub soil inert: Influence of sub soil on the soil and on the life of plants.

*Agricultural Geography*:—Astronomic situation of France: Mountains: Valleys, Plains, Rivers.

*Agricultural Physics*:—Atmospheric Air: Caloric: Light: Darkness.

*Agricultural Meteorology*:—Winds: Fogs: Dew: Rain: White Frost: Frost with Ice: Snow: Hail.

*Climatology*:—Influence of Climate: Climate of France: Regions.

*Fertilization*:—Considerations preliminary: Fecundity and Fertility.

1. *Improvement*:—Clay: Rocks: Sand: Slates: Lava: *Plombage*: Irrigations: Ditching: Ploughing: Movement of the sub soil: *Colmatage*.

2. *Stimulants*:—Stimulants of Mineral Origin: Lime: Marl: Calcareous earth: Broken shells: Sea sand: the Whiting: Shell fish: Plaster: Fire Ashes: Sulphate of Iron: Salts of Potash: of Soda: of Ammonia.

*Stimulants of Vegetable Origin*:—Soot: Ashes: Leached Ashes.

3. *Manures*:—Animal Manures: Excrements: Urine: Pigeons' Dung: Guano: Excrement of Animals: Muscular Flesh: Blood: Fish: Fat: Oil: Woolen cloth: Horn: Horse hair: Human hair: Feathers.

*Vegeto-Animal Manures*:—Litter: Horse dung: of Sheep: of horned Cattle: of Swine: of Rabbits.

*Animal Manures Mineralized*:—Animal charcoal: Bone.

*Vegetable Manures*:—Green crops ploughed in. Manure and Aquatic plants: Turf: poor Vegetables: Oil Cake: Tan: Mesh: pulpy matters: Leaves: Stubble.

*Liquid Manures*:—Urine of the Domestic Animals: Flemish Manures: Urine Water from *Fecularies*.

*Compound Manures*:—Manure of Jauffret and Lane: Compost: Slime of Ponds: River Mud: Marine Mud.

*Breaking up the Soil*:—1. Work Animals: Cattle: Horses: Cows: Mules: Asses: Race: Age: Mode of tackling: Length of working: Treatment: Necessary proportion.

2. *Instruments*:—Plough with or without fore wheels: Harrow: Scarifiers: Rollers: Instruments for second dressing: Weeders: *Extirpators*: Necessary proportion.

3. *Tillage*:—Theory and Practice: Soil: Temperature: Flat Tillage: Flat Tillage in rows: Flat Tillage in ridges: Tillage by digging and by grubbing.



4. *Methods of moving the earth* :—Harrowing : Rolling : Second Ploughing : *Buttages*.

5. *Clearing Land* :—Heaths : Woods : Peaty lands : Clearing by the hand : by the Plough : Hoeing : Destination of the ground.

*Draining* :—Arable Land : Morasses : Ponds : Nature and destination of the soil.

*Irrigation* :—Theory and Practice : by Infiltration : Renewal of the Water : *Planches Bombees*.

Quantity of water by the acre, and according to the nature of the soil. Value of the bottoms irrigated and not irrigated. Mode of working these almost irrigated. Fertility and value of the products.

*Fences* :—Walls : Ditches : Hedges, living or dead.

*Sowing* :—Theory and practice : Sowing in lines : at random : selection, renewal, cleansing, and preparation of the seeds : Burying them by the harrow : by the plough.

*Method of Treatment* :—Weeding : Cleaning of thistles : stripping off the leaves : (*Effuillage* :) Bringing into the light.

#### *Harvesting. General Considerations.*

1. *Harvesting of Fodder* :—Instruments and Machines : Mowing : Hay making : Grindstones.

2. *Harvesting of Grain* :—Instruments and Machines : Mowing : Reaping : Threshing : *Liage*.

3. *Harvesting of Roots* :—Pulling up by the hand : by the plough : Uncovering : Cleaning.

*Selection of the methods of preparing the Soils* :—According to atmospheric circumstances : Nature of the Soil : its condition : its destination.

*Distribution of Labor by Rotation* :—Normal conditions : Exceptional conditions.

#### *Rural Architecture.*

*Materials* :—Siliceous, calcareous and argillaceous rocks : Fat, meagre, and hydraulic Lime : Sands : Mortar : Cements : Puzzolana : Plaster : Wood : Iron : Paving Brick : Roofing Slate : Tiles : Lead : Zinc : Leather : Ropes.

*Works* :—Foundations : Terracing : Properties of Earths.

*Masonry* :—Foundation Walls : High Walls : for support : for inclosure : Plastering : Pise.

*Carpentry* :—*Assemblages* : *Combles* : *Pans de bois* : Partitions : Staircases.

*Joiners' Work* :—Floors : Gates : Windows : Shutters.

*Iron Work* :—Large Iron : Ironing the Buildings.

*Roofing* :—Tiles : Slate : Thatch : Zinc : Bitumen.

*Painting and Glazing* :—Oil Painting : Distemper Paintings : Badidgeon, (coloring) Window glass.

*Paving and Bricking*.

*Estimate of the Works* :—Masonry : Carpentry.

*Specification* :—Form of the works.

*Edifices* :—Stable : Cow house : Sheep fold : Hog pen : Hen house : Pigeon house : Silk worm nursery.

*Animal products* :—Dairy : Cheese house.

*Vegetable products* :—Barns : Granaries : Wine cellars : Cellars : Corn pits . Ovens.

*Agricultural Manufactures* :—*Feculary* : Distillery : Sugar manufactory.

*Reservoirs* :—Watering places : Wash house : Wells : Cisterns : Ditches for urine : Ponds.

*Dwelling house* :—Form and Proportion.

*Irrigations* :—Dams : Taking out the Water : Sluices : Canals : Weirs : Slopes.

*Drainage* :—Damming up : Trenching : Cespool : Machines for drainage.

*Routs* :—Soil : Slope : Outline : Leveling : Materials : Support : Bridges : Estimate of Excavation and Embankment.

*Group of Edifices composing a Farming Establishment* :—Relation to the fertility of the soil and the culture and extent of the farm.



*Imperial Forestry School.*

The Imperial Forestry School is situated at Nancy, on the Meurthe, and is intended to instruct and train young people destined for the service of the forests. It appertains to the Department of the Minister of Finance, who fixes annually the number of students. The school has a director, also *conservateur des forêts*, a subdirector who is also professor, four other professors, and a *répétiteur* of forest economy. It is a boarding school, and the pupils wear a uniform.

In order to be admitted to the school the candidate must be a French citizen, between the ages of 18 and 22, of good constitution, and must possess the diploma of bachelor in sciences, or a certificate of classical studies as far as rhetoric, with a diploma or an official document certifying that his attainments entitle him to a diploma. If he has the degree of bachelor of letters he will be credited with fifty points in the examination record. He must also bring a bond engaging to pay to the school an annual sum of 1,500 francs during the school term, and of resources amounting annually to 600, from the time of his leaving the school until receiving the grade of *garde général*, and a written declaration of the place of examination chosen by the candidate in the arrondissement of examination, and of the place of residence of his family, or of that place where he finishes his studies, provided that he studied from the beginning of the academical year. Upon complying with these requisitions the candidate is authorized by the General Director of Forests to present himself at the competitive examination for admission, which takes place annually in July. This examination includes arithmetic, algebra, geometry and its applications, trigonometry, physics, chemistry, cosmography, mechanics, natural history, French history and geography, and the German language, after a plan published by the Minister, and covering the course of the lyceums. There are also written exercises on mathematics, surveying, French narration, and German composition; also a sketch in free-hand drawing and in water colors. He must present also specimens of arithmetical calculations, and several of drawing, performed at the school last attended, and if these are not satisfactory the candidate is immediately rejected. He is also subjected to a physical examination.

The course lasts two years, and includes natural history, forest economy, legislation, drawing and construction connected with the forest service, and applied mathematics.

There is an examination at the close of the year, and after the final examination graduates are sent into the most important forest districts, with salaries of 1,200 francs, to learn under the direction of the forest inspectors, the practical part of the profession, and when capable they receive appointments as *gardes généraux*, as vacancies occur.

There are in the school four bursarships for the children of forest agents.

*School of Shepherds.*

In pursuance of the recommendation of a commission on agriculture, a school for the instruction and practical training of shepherds has been established in the department of the Pas-de-Calais, on the Imperial sheep farm, Hautingay. The farm comprises about 500 acres, and is well stocked with a flock of merinos and half-breeds. We have not seen the regulations or programme of instruction.

*Farm School for Vine Culture.*

Six new Farm Schools were established in 1868,—two of them devoted to the cultivation of the vine, one for the department of the Gironde, and the other, of the Doubs.



*Departmental Professorships of Agriculture.*

In addition to these formal means of agricultural instruction the minister of this department has established professorships in nine departments, the occupants of which travel about for the purpose of making the farmers acquainted with new methods of culture, and with new discoveries in agricultural science.

*Agricultural practice in Orphans' and other beneficent institutions.*

The government grants certain subsidies to institutions which receive orphans, or children dependent upon their parents, or belonging to the hospitals, or of poor families, as well as several reformatory and rescue institutions, in which the inmates perform simple agricultural work.

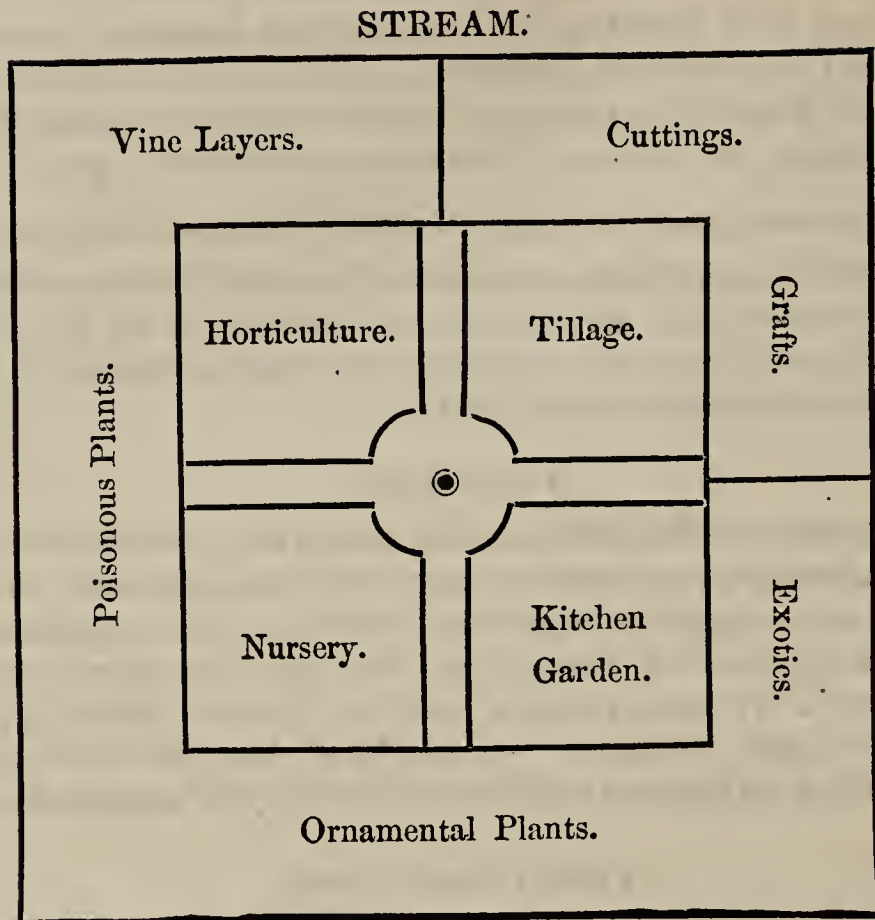
*Normal Schools.*

Attached to many of the public normal schools are grounds sufficient for orchard and garden purposes, which are improved by the pupils under the direction of a special teacher of agriculture and rural economy. This department of study is placed by an ordinance of December 22, 1864, under the general inspectors of agriculture, and a systematic course of study and practice, extending over three years, has been made obligatory. Out of 778 of these establishments, 44 are furnished with all the land and requirements necessary for an extended course.

*Public Primary Schools.*

In advance of positive legislation, teachers had introduced occasional instruction in the principles and details of agricultural operation. In many districts the teachers are furnished with residences having grounds attached, and on these the pupils were allowed and encouraged to apply the instruction of the school-room to practice, until 1865, it was found that in 5,572 schools, valuable agricultural teaching was pursued, and in 20,220 schools, teachers and pupils found recreation and profit by attention to garden and fruit culture. By a decree of February 11, 1867, a joint commission was instituted by the minister of public instruction and of agriculture, to investigate and propose the measures necessary to develop agricultural studies in the communal and adult schools of the agricultural districts.

In 1866, M. Malgras, academical agricultural inspector, issued a circular to school-masters of the Vosges, urging upon those who gave instruction in farming and gardening in the public schools, to accompany their pupils from time to time to the best kept farms of the district, to make a special study of the stables, fields, cattle-houses, and vineyards, of those who received medals for their good farming or management. They are especially enjoined to make their own gardens practical schools of instruction, and to cause their pupils to make a plan of the gardens and the lands placed at their disposal, indicating the boundaries, walks, beds, trees, and other objects. Several of these plans, with the name of the commune, teacher, and pupil, were exhibited at the Industrial Exhibition of 1867, and some of them received prizes for the accuracy with which the drawings were made, and excellence of the designs on which they were plotted. The following plan of an agricultural garden of the master attached to the public school at Bourbaek-le-Bas, in the Canton of Taun, was noticed with approbation in the Reports of the *Delegations Ouvriers*:



The Report observe on this plan :

We are of opinion that the construction of such a garden in all parishes where agriculture is the chief occupation of the inhabitants, would tend to produce a great reform in cultivation and rural economy. It would be the means of compelling some of the farmers to throw aside certain old customs of their forefathers, which many are unwilling to abandon. We in no way blame them for respecting old traditions, nevertheless, if it were explained to them that a change for the better were possible, we should be at a loss to comprehend their hesitation to replace an old system by a new one, the result of careful study under their own eyes and with their assistance.

Those who have lived in the country will have noticed that the lands of the petty farmers are generally the worst cultivated. The cause of this may be attributed to ignorance, which we have before condemned, and to the execrable principles of individualism. The idea of association or partnership which is beginning to develop itself among the industrial classes as being the only means of saving labor from the oppressive power of capital, does not strike the agriculturist favorably, and the words association and communism are often confounded. There is, however, this difference; whereas citizens, in entering into partnership for the purpose of improving and increasing their productions, are free to live and dispose of their share of the profits as they choose, in communism their powers are restricted, and the principle is an absolute one. This error of the country people is, however, easy to be understood; darkness still reigns over them all-powerfully.

Government has undertaken the mission of sending men, especially qualified, to initiate agriculturists in any new methods of cultivation, or in any great discoveries relating to the theory of agriculture. We would wish to see the extension of these missions to all the rural districts, in the form of conferences. This system would be of greater benefit to the farmers.

Should not the large rural estates be, as it were, so many model-farms, the management of which would offer to those who possess them as many attractive pleasures as the more or less repeated visits to the cafés on the boulevards of the capital, or the nights spent in gambling.



# SPECIAL SCHOOLS, AND INSTRUCTION

FOR THE MERCANTILE AND MILITARY MARINE.

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## INTRODUCTION.

THE necessities of the maritime service in France, public and private, military and commercial, have created a system, or at least a series of special schools for children whose parents are occupied on the sea, or youths preparing for the exigencies of naval affairs, several of which we will proceed to describe, with the aid of official documents,\* without reference to the chronological order in which they have been instituted. The system includes

1. Nautical School for the Orphans of Sailors.
2. The Inflexible and other School-ships.
3. Naval Apprentice Schools at the government naval stations.
4. School for Boatswains and Shipmasters.
5. School for Naval Engineers and Stokers.
6. Naval Drawing School.
7. Schools of Navigation and Hydrography.
8. Naval School at Brest.
9. School of Naval Architecture at Paris.
10. School of Marine Artillery.
11. School of Hydrography.
12. Naval School of Medicine and Pharmacy.

In addition to the schools above enumerated, several of which will be described in detail, the French government has now under consideration the establishment at Paris of a Central School of Commerce and Navigation. The instruction, while it will be special, will not be technical, and will be designed for young persons who propose to enter either the military or mercantile marine, leaving the practical details of the particular branch of the service to be acquired elsewhere.

A system of maritime conscription for recruiting the navy, and strict regulations requiring special instruction in masters and mates of all mercantile vessels, are in force in France.

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\* Official Report on Paris Industrial Exhibition of 1866, group X. Official programmes of the several schools noticed.

## NAUTICAL SCHOOL FOR ORPHANS OF SAILORS.

Formerly, when the children of sailors were obliged at the age of seven to leave the asylums (*salles d'asile*), which are open to them with such liberality, they had to stay for six years in the primary schools before they were admitted to the "school for young sailors" (*école des mousses*), where their professional education commenced. This state of things, entirely satisfactory when the child belongs to a family, is different when it is an orphan. Then there is a void to be filled.

An imperial decree, published Nov. 15th, 1862, at the suggestion of the Marquis of Chasseloup Laubat, provides for this want by furnishing at Brest an institution for the orphans of the navy, and placing it under the especial protection of Her Majesty, the Empress. Vice-Admiral, Count de Gueydon, gave all his care to the organization of this especial school, which was intended to gather the orphans of seamen, to place them under the protection of the navy, to educate and instruct them that they might follow in the steps of their fathers. They were placed under the supervision of lieutenant Picard of the navy. Their general instruction was confided to the *Brothers of the Christian Schools*, and the "Daughters of Wisdom" (*filles de la sagesse*) were intrusted with all the cares which such young children require.

We have nothing to say in this place of the excellent primary instruction given in this school, and will only notice briefly the special or professional instruction, which is imparted in a military style by divisions, subdivisions, companies, sections, squads commanded by masters, second masters, quarter-masters, and naval instructors. There are three sizes (the low, middle, and high,) each of which is commanded by a pupil.

The lessons which they receive consist of instruction in the management of sails, sailor's practice, (*école de matelotage*), the whistle, fife and drum, rowing, swimming, military practice, gun-practice, bayonet-practice, bats, *eillon*-drill, principles of music, gymnastics, and boxing. There is likewise given to them a physical and military education, which develops their strength and gives them the ability to study more closely.

On the 1st of January, 1867, there were in the school 415 pupils. Most of them are sent to the Seamen's School (*école des mousses*), when they have attained the thirteenth year of their age; those who are not considered fit to serve in the navy are struck off the lists and returned to their families.



Name of School.	3d Degree.	2d Degree.	1st Degree.
School of maneuvering on the naval gymnasium.	40 learn to mount to the mast-head and to hold themselves on the sail-yards.	185 are just learning to take in the sails and the reefs, and to make knots and splices.	190 take in the reefs and make knots and splices.
School of whistling.	20 learn to whistle.	10 give almost all the blasts of the whistle.	20 give all the blasts of the whistle.
School of rowing.	30 learn to row.	90 are just learning to row.	90 row.
Infantry school.	255 are drilled without arms.	20 are not fit yet to join the battalion.	140 are drilled in the gun-practice, bayonet-practice, and form a battalion.
School of the fife and drum.	8 commence.	10 do pretty well.	7 do well.
School of gymnastics.	50 commence the elementary movements.	10 do pretty well.	30 do well.
School of music.	125 commence.	140 do pretty well.	150 do well.

The following table shows the number of pupils that had entered and left the school, up to Dec. 31, 1866 :

	1863.	1864.	1865.	1866.
Number of pupils on the 1st January,	—	224	256	420
Entered during the year,.....	247	102	235	157
Total,.....	247	326	491	577
Left during the year. { Sent to the school ship,..	15	53	42	93
{ Sent back to their families,	6	15	25	67
{ Died in the hospital,.....	2	2	4	2
	23	70	71	162
Present on the 31st of December,.....	224	256	420	415

THE INFLEXIBLE AND OTHER SCHOOL-SHIPS, AT BREST.

For a long time the children of sailors were placed on board the vessels of the fleet, where they lived in a state of servitude, and frequently arrived at a mature age without being able to read or write, while the gasket of the sailor formed characters which would not yield to any moral suasion. It is only since 1822 that they received, before being placed on board the vessels, an elementary and professional instruction, and since that time the school-ship has

become the principal seminary for naval officers. The children must be at least twelve years old and their parents pledge themselves not to take them away from the school till they have reached the age of eighteen.

The school-ship, first established at Brest in 1823, was transferred to a corvette in 1836, to a frigate in 1851, and finally, in 1861, to the man-of-war, "*l'Inflexible*," where it numbers at present 900 pupils from the age of 13 to 15. They remain here at least one and not more than two years, and receive a primary and professional instruction. After leaving the school they are placed on vessels of the fleet, where they continue to be under the special superintendence of the naval department. Even here they go through a regular course of instruction, given by one of the officers, and have thus an opportunity to continue the studies commenced on board the school-ship.

It would lead us too far here to enumerate in detail all the exercises performed on board the *Inflexible*. It will suffice to say that besides school instruction, the pupils are progressively accustomed to the practice of their profession, and learn every thing which a sailor can be taught on board a vessel ; the washing and cleaning of the vessel and of their linen, the rigging of the mast, the maneuvering of sail-boats and row-boats, which occupations fill the morning hours. After dinner, which takes place at 11 o'clock, they go on board two brigs, where they study and execute alone all that constitutes the practical art of the sailor.

It is not to be wondered at that these young sailors on board the *Inflexible* get a liking for their occupation. Always in the open air, with good clothes, varied bodily exercises and abundant food, they acquire robust health and a thorough knowledge of their profession. Whilst two companies tack, two others go through military exercises with rifles or guns, taking them to pieces, lashing the pieces, and in various ways maneuvering with the mountain howitzer, bayonet-fencing, &c. Some go to the sail-maker's room and make hammocks. In 1857 there were selected 16 sail-makers and 20 steersmen from those in each company who showed most aptitude and taste for these specialties. This classification of the young sailors according to their professional ability, has produced very excellent results.

More recently still (by an imperial edict of Aug. 11, 1868,) a special section of sailor apprentices has been formed on board the "*Inflexible*" for children, who have not the required size and strength, (*taille*;) they are received into the school as apprentice sail-makers,



carpenters and calkers. Pupils, after having reached the age of sixteen, are transferred to the school-ship *La Bretagne*.

The following table will give the statistics of this school to 1866.

Date of Admission.	Number Admitted.	Left.					Total.
		Chief of the Topmast.	Topmen, (gabiers.)	Flying Top-men, (gabiers to-lants.)	Supplement-ary.	Left the Navy, or died.	
Present April 1, 1861..	493	.....	.....	.....	.....	.....	.....
Admitted in 1861....	275	10	32	32	12	10	96
“ “ 1862....	712	30	202	66	157	54	509
“ “ 1863....	579	30	183	115	205	38	571
“ “ 1864....	580	31	173	152	212	28	596
“ “ 1865....	545	33	191	115	186	64	589
“ “ 1866....	540	39	190	110	158	72	569
Total.....	3,724	173	971	590	930	266	2,930

The chambers of maritime commerce at Bordeaux, Cette, Marseilles, Ajaccio, Havre, &c., have established similar nautical schools and placed them under the supervision of the government.

#### NAVAL APPRENTICE SCHOOLS.

There have been since 1824, in every one of the five naval stations of France, elementary schools, intended to give to the apprentices in the various workshops a degree of elementary knowledge, on the system of monitorial or mutual instruction. After some years of prosperity they were abandoned, in consequence of the great aversion then generally manifested against this method. The only one that remained was the school at Rochefort, which was under the superintendence of the Brothers of the Christian Schools. But in 1828 and 1829, under the ministry of Martignac, the Baronet Hyde de Neuville ordered their reestablishment. Every one of these schools organized itself in its own way, and it was only in 1851 that a decree of April 7th prescribes uniform regulations.

We have nothing to say here on these apprentice-schools, which are simply primary schools for adults, to which are added special schools for rowing. Their professional instruction is given in the various workshops of the port, to which they have been assigned; the apprentice school has had during the year 1866, 954 pupils.

#### SCHOOLS OF BOATSWAINS.

The navy maintains schools called “*école de maistrance*” (*maistrance* corps of under-officers of a ship,) where a certain number

of workmen from the arsenals, chosen by open competition, receive the special, theoretical instruction required for the boatswain and foremen of the various workshops.

The origin of these establishments goes back as far as 1819. A circular from the Secretary of the Navy, the Baronet Portal, of Aug. 17th, decreed the establishment, at the ports of Brest, Rochefort and Toulon, of special schools, in which a certain number of young workmen, destined for the "board of shipmasters" (*maistrance*) and chosen from among the most intelligent ones, should go through a theoretical and practical course of ship-building. The same circular contained a provisional regulation, giving the rules to be observed in these schools. The number of pupils in each was limited to 12, of which 8 should be carpenters, 1 pulley-maker, 1 blacksmith, 1 locksmith, 1 cooper, &c. These pupils should be chosen from among the most intelligent and best-behaved apprentices and young workmen. They must know reading and writing, have served two years in one of the ports, and be at least eighteen and not more than twenty years old. The supervision of these schools was confided to a naval engineer.

We have just given an outline of the programme of admission required in 1819, because it is an official indication of the state of primary instruction at this period; but the same regulation proves that it was too high yet, for the minister allowed, for the first two years, the limit of age to be extended to 25 years.

The course of instruction which was to be given, comprised the first elements of mathematics, elementary geometry, the first elements of rectilinear trigonometry and the first elements of statics, &c. This course of studies was to last two years, and a system of examination and prizes was organized.

It was generally supposed that such an organization would obtain great success, and that the advantages which it presented would attract many pupils. But such was not the case. The working classes at that time were very much neglected, and there were very few who could read or write. Moreover the working men did not receive any pay whilst attending the school, and thirdly, there was no opportunity for these young men to perfect themselves in the practical exercises of their profession during the two years they studied the theory. The necessity of making some modification became clearer every day, and this was done by a royal decree of Feb. 9th, 1833.

Instead of choosing the pupils, competition was substituted, and as the primary instruction had advanced, candidates were required



to be able to read fluently, to write neatly and correctly, and to be acquainted with the rudiments of arithmetic; they must be workmen of the first or second class, must be 21 years old and have served for three years in some port; finally, they must furnish a certificate of their professional capacity, given by the foreman of their workshop, and countersigned by the director.

The course of instruction was to last two years, but the theoretical studies were confined to the first year; the second year was exclusively devoted to the practical application of the various professions of the pupils, the number of whom was increased, the recruits coming to a great extent from the naval ports. Brest was to receive 24, Rochefort 14, and Toulon 14; 52 in all, instead of 36.

In spite of the abolition of the limit of higher age, which gave a larger number of pupils access to the school, the recruiting of pupils still presented great difficulties. These were partly obviated by admitting assistant boatswains, and even boatswains, who were paid by the day. This measure was productive of very happy results; the number of pupils was soon increased and the studies were pursued with greater vigor.

The republican government, likewise, devoted its attention to these schools. A decree ordering a reorganization, was published April 23, 1856, and is to the present day in force. The conditions of admission were retained and extended to workmen of the third class; the number of pupils assigned to each post was somewhat changed; the course of instruction was to last two years; during the first, the pupils spent the whole morning at the school, and during the second, only three mornings per week. Finally, it was agreed that the pupils were to be paid for the time which they devoted to the school, just as if they had worked in the dockyard.

#### PROGRAMME OF INSTRUCTION.

In order to make the scientific instruction of more practical use, the following programme was fixed for each year.

*First year.*—Arithmetic, logarithms, square cube roots; 2, geometry; 3, elements of descriptive geometry; 4, elements of algebra up to equations of the second degree; 5, linear drawing; the course of arithmetic and algebra lasted a month and a half, from 10 o'clock till noon, instruction in drawing from 8 till 10. The two last months of the year were employed in reviewing all that had been taught during the year, and in preparing for the examination.

*Second year.*—1, Common mechanics; 2, workshop accounts; 3, drawing. The course of mechanics and workshop accounts lasts

two months. The half-day spent at the school is divided into three parts; the first is occupied in drawing, and lasts two hours; the second (either mechanics or workshop accounts) also two hours; the remainder of the time is devoted to optional studies. When the course of mechanics and workshop accounts is finished, the pupils are divided into two sections; the first comprises the carpenters, and workmen of similar rank; the second the mechanics and workers in metal. During two months and a half the professor of mathematics teaches the section that works in wood the application of geometry to the drawing of working plans, explains to them all the details of the drawing of the frame, the stern, the bow and pieces, &c. He teaches them to calculate the *deplacements* from the centre of the keel, or metre-centre. Finally, the pupils are taken to the molding-loft, in order to trace there a vessel in its true dimensions under the directions of a drawing-master. The metal-workers receive instructions from the professors of mathematics, on the property and application of steam; the functions of the various parts of a steam-engine; the applications of descriptive geometry to the drawing of the different parts of the steam-engine, &c.

The instruction in drawing receives in these schools all the attention which the development of naval construction demands. During the first year the pupils learn successively shading strokes of different thickness, simple and dotted; the construction and use of ladders. After this preparation, which applies to all, they execute professional drawings; the carpenters, plans of vessels after a copy; the mechanics, plans of steam-engines and steam-boilers, &c. The time devoted to drawing during the second year is employed by the carpenters in drawing a fair copy of the complete furnishing material of a vessel, the details of the masting, the capstan, the helm, &c.; by the metal-workers in drawing a fair copy of the various machines. All these courses of instruction have been attended with satisfactory results; most of the pupils who have not been able to draw a straight line before entering the school, on leaving can draw in a creditable manner the working-plan of a vessel as well as of the most complicated machines.

From its foundation in 1819 till the end of 1862, the *Echo de maistrance* at Brest has been attended by 429 pupils, viz. :

275 pupils actually in the service, viz. : 34 pupils; 60 workingmen; 57 assistant boatswains; 100 boatswains; 24 paid boatswains.

59 pupils died in the service, viz. : 5 pupils, 15 workingmen, 7 assistant boatswains, 22 boatswains; 7 paid boatswains; 1 naval storehouse-keeper.

95 pupils left or were discharged.



To get an idea of the manner in which the pupils pass the examination on leaving, it will be seen from the following table, which shows the results in the school at Brest during the last five years, that the instruction given has not been lost. The same is the case at Rochefort and Toulon.

Years.	Number of pupils who have attended the school.				Total number of pupils.
	With great success.	Successfully.	With good results.	Without result.	
1862	6	5	13	3	27
1863	3	4	20	—	27
1864	5	5	15	4	29
1865	3	6	14	1	24
1866	6	9	14	—	29
Total,	23	29	76	8	136

SCHOOL FOR NAVAL ENGINEERS, STOKERS, ETC.

Since the introduction of steam into navigation, it is indispensable to have well-trained stokers and mechanics, men who enjoy robust health, great presence of mind, prudence and an inventive genius when facing difficulties, skill in working metals, a knowledge of elementary mathematics and its application to their labor. In order to prepare such men, two special schools have been established by an imperial edict of Sept. 24, 1860, one at Brest, on board the *Urania*, and another at Toulon, on board the *Jena*. To be admitted to these schools, the conditions must be fulfilled which are required for the various grades in the *personnel* of a steam vessel.

In order to recruit these schools, all the blacksmiths, braziers and weighers, (*ajusteurs*) who belong to the annual contingent of the army, may be sent officially, or at their own request, to the ports of Toulon and Brest, to be incorporated in the companies of mechanics of the navy. Civilians are admitted by contracting a voluntary engagement as stokers. All, however, must undergo an examination in manual labor, to show their physical capacity.

The course of instruction for stokers who are candidates for the grade of quartermaster, comprises, 1, arithmetic up to and including the rule of three, and square roots; 2, common geometry up to and including spherical bodies; 3, a concise knowledge of mechanics, and physics; 4, description and classification of steam-engines for vessels; the adjusting of their various parts, a concise knowledge of the property of metals and their use; 5, the practical management of machines and steam-boilers; 6, the repairing of machines.

It is evident that this instruction attracts to the service of the navy many intelligent and industrious young mechanics who would not enter it, because, not possessing the special knowledge required, they would not run the chance of remaining for a long time in the lowest grade, viz.: that of working stoker, the only one to which their attainments would allow them to aspire. In following this instruction, however, attentively and passing their examination successfully, they obtain the rank of pupil mechanics, and even of quartermasters. In continuing their studies, they can rise still higher; their schools furnish them with the means, if they wish to become second boatswains. To the knowledge already acquired are added: 1, arithmetical progression; 2, the whole of planimetry; 3, theoretical mechanics and physics; 4, theory, description, regulation, and construction of steam-engines and steam-boilers; 5, the working and repairing of machines. By further pursuing their studies and working diligently, they can rise from second to first boatswain, and may ultimately obtain the position of principal mechanic, with the rank of lieutenant on men-of-war, and even of captain on corvettes, if they became chief mechanics. The following table, giving the statistics of the school at Toulon, will show the success with which these schools have been attended.

Designation of the different grades.	Number of pupils who have attended the school during the half-year.						Number of pupils prepared at the school, who underwent an examination.						Number of pupils who were successful at the examinations.					
	COMPETITION OF						COMPETITION OF						COMPETITION OF					
	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.
For 1st Boatswain,	38	34	35	23	19	13	29	24	26	10	14	13	15	10	12	8	8	10
2d Boatswain, (theoretical),	49	41	44	31	13	22	31	37	31	22	11	22	18	22	16	9	7	19
2d Boatswain, (practical),	25	29	12	4	3	3	23	15	7	4	3	3	16	10	7	4	3	3
Pupil Mechanic, . . . . .	6	5	23	3	—	1	4	5	14	2	—	1	1	2	2	—	—	1
Quartermaster, (theoretical),	129	124	67	36	32	19	115	108	35	34	—	12	99	97	27	26	—	11
Quartermaster, (practical),	4	2	—	—	—	—	3	2	—	—	—	—	2	2	—	—	—	—
Total, . . . . .	251	225	181	97	67	58	205	191	113	72	28	51	151	149	64	49	18	44

*Note.*—Since the 1st January, 1865, the number of candidates being too great, the number of pupils has been reduced, but may again be increased, when occasion demands it.

#### NAVAL DRAWING SCHOOL.

An edict issued by Napoleon I, Sept. 27th, 1810, established at Brest and Toulon, on board the *Duquesne* and the *Tourville*, drawing-schools for those who wished to enter the naval service, where theoretical and practical instruction was given. At the foundation



of the naval school at Augoulême in 1816, these drawing-schools were transferred to the shore, became less exclusive, and admitted to their gratuitous course all young men from these two great naval stations who wished to adopt the naval profession. They have always been very largely attended.

#### SCHOOLS OF NAVIGATION AND HYDROGRAPHY.

Long before the navy had acquired any importance, maritime commerce had been immensely developed. The coasting and ocean trade required experienced and well-informed sailors. There were therefore in the principal seaports, gratuitous schools of navigation, whose aim was to disseminate theoretical knowledge. These schools were well conducted from the year 1584, when Henry III issued the first ordinance on the subject, by which boatswains and captains of merchant vessels had to undergo an examination of qualifications; but opportunities of instruction were wanting at that time, and it was reserved for Louis XIII to fill this void.

During the memorable siege of La Rochelle, Cardinal Richelieu became convinced that the knowledge of a captain, to whom the State intrusts a merchant-vessel, ought not to be confined to the most simple rules of the art of navigation. He consequently, in January, 1629, published a decree, ordering the establishment of schools of hydrography, open to all who intended to study navigation theoretically. The king himself engaged to maintain, at his own expense, a certain number of such schools, and encouragements were held out to all cities which would found such schools. The professors of hydrography were detained to assist at the examinations of captains, boatswains and coxswains.

Such was the origin of the first professional instruction in navigation. Here, as in all institutions of learning, the instruction of manhood succeeded that of youth. If the orders of Louis XIII were not as generally executed as they deserved, they were instrumental in producing a certain number of learned hydrographers, some of whom became the authors of the first treatises on navigation ever published in the French language.

A decree of Louis XIV, (August, 1681,) another by Louis XV, (September 14, 1764,) and third by Louis XVI, (January 1, 1786,) show that the ancient monarchy did not lose sight of this branch of instruction. In the last mentioned decree, the Marquis of Castries, Secretary of the Navy, united under one common law all these establishments, whose organization was far from uniform. The professors were in future chosen by competition. Two chairs of

“hydrographic examiners” were created, charged with the superintendance of the instruction, to assist at the examinations.

A decree of the National Assembly, which became a law, August 16th, 1791, decided that gratuitous schools of hydrography should be established at the expense of the State, in thirty-four different places. This decree was supplanted by others published a few years later, further regulating the course of instruction.

During the wars of the first Empire, Napoleon I never forgot to extend the benefits of French institutions wherever his armies were victorious. To this circumstance several foreign seaports owe their excellent schools of navigation.

The hydrographic instruction was completely reorganized by a royal edict of August 7, 1825, under the ministry of Count de Chabrol. This is still in force with but few modifications. One professor is charged with giving instruction in each of the 42 schools of the Empire; two examiners have charge of the general supervision of these schools, and hold the annual examinations.

Instruction is gratuitous, and sailors can enter from the age of 13 upwards, but they rarely attend them before they are 22 or 23 years old. The professors, on five days of the week, impart instruction for four hours a day. There are two different courses; one superior and the other elementary; the first theoretical and practical, the other essentially practical. Wherever there is an observatory, the pupils are practiced in observations.

The programme of the theoretical instruction comprises: for ocean voyages, elements of arithmetic, algebra, geometry, trigonometry, elements of astronomy, navigation, use of instruments and nautical tables, elementary knowledge of steam-engines, as applied to navigation, French composition; for the coasting-trade, elements of practical arithmetic, geometry, practical navigation, elementary knowledge of steam-engines, nautical calculations. The examinations are annual, and no one is admitted to the practical examination, unless he has reached the age of 24, and has served five years on a French vessel. It comprises rigging, management of sails, a knowledge of coasts, currents, tides, and gunnery. After the practical examination has been successfully passed, the pupil must undergo the theoretical one.

For the results produced by these establishments, the average attendance of the schools of navigation, and the number of sailors, who have become captains or boatswains, we refer to the following tables.



*Number of sailors who have attended the schools of hydrography from 1849 to 1866 ; of candidates who have obtained the rank of "captain" for sea voyages, or "boatswain" for the coasting trade.*

Scholastic Year.	NUMBER OF SAILORS.			
	Pupils of the Schools.	ADMITTED AS		Total.
		(of the sea voyage.) Captains.	(of the coasting trade.) Boatswains.	
1849-50	1,307	163	331	494
1850-51	1,347	187	369	556
1851-52	1,344	156	325	481
1852-53	1,324	168	317	485
1853-54	1,255	208	292	500
1854-55	999	151	178	329
1855-56	1,116	148	182	330
1856-57	1,804	253	493	746
1857-58	1,907	252	426	678
1858-59	1,568	258	354	612
1859-60	1,525	234	278	512
1860-61	1,424	253	263	516
1861-62	1,422	213	244	457
1862-63	1,424	229	252	481
1863-64	1,571	279	276	555
1864-65	1,410	309	260	569
1865-66	1,205	270	278	548
Total, .....	23,952	3,731	5,118	8,849
Ann. average,	1,409	219	301	520

*Ports where schools of hydrography are established, with the average number of pupils who annually attend every school, collected from official documents since the year 1849.*

Ports.	Number of pupils.	Ports.	Number of pupils.
Dunkerque,.....	58	Saint-Nazaire,.....	24
Calais, .....	8	Nantes, .....	77
Boulogne, .....	7	Les Sables-d'Olonne,.....	37
Saint-Valerie-sur-Somme, ...	21	La Rochelle,.....	11
Dieppe, .....	11	Rochefort, .....	86
Fécamp,.. ..	24	Blage, .....	27
Le Havre,.....	39	Bordeaux,.....	50
Rouen, .....	5	Bayonne,.....	17
Honfleur, .....	11	Saint-Jean-de-Luz,.....	16
Caen,.....	19	Narbonne,.....	29
Cherbourg, .....	70	Ogde,.....	42
Granville, .....	37	Cette,.....	24
Saint-Malo, .....	116	Arles, .....	16
Saint-Brieuc,.....	30	Martigues,.....	13
Paimpol, .....	28	Marseilles,.....	50
Morlaix, .....	19	La Ciotat,.....	8
Brest, .....	74	Toulon, .....	72
Douarnenez, .....	9	Saint-Tropez, .....	20
L'Orient, .....	94	Antibes,.....	16
Vannes, .....	34	Nice, .....	9
Le Croisic, .....	27	Bastia,.....	30

## THE NAVAL SCHOOL AT BREST.

NAPOLEON, in 1810-11, established the first naval school-ships in France, the *Tourville* being chosen for that purpose at Brest, and the *Duquesne* at Toulon. These schools were placed under the orders of the maritime prefects of the two ports. In 1816, these two schools were abolished by decree, and a royal marine college was established at Angoulême. Several other changes took place, and in 1830 the college was replaced by a naval school on board the *Orion*, an old 74; this vessel was succeeded by several others, all of which have received the name of the second school-ship, the *Borda*, named after Captain Borda, a naval officer of great scientific and practical ability. The present ship is a noble three-decker, pierced for 120 guns, was launched in 1847, and took part in the Crimean war.

The *Borda* is stationed at Brest, and its rigging has been reduced to that of a frigate. The forepart of the second gun-deck of the vessel still retains something of its old character, and is provided with six guns on each side for practice. The other parts of the vessel have been completely altered; the decks have been cut away, so as to form two large lecture-rooms and two school-rooms. Not only the pupils but also their professors and most of the officers are lodged on board the vessel. On deck are specimens of various kinds of guns in use in the French navy, and a gymnasium. The quarter-deck, which is continued to the mainmast, is divided, the forepart being appropriated to the pupils, and the aft to officers.

Candidates are admitted to this school after a public examination, which occurs annually. For admission to the examination the applicant must prove his French birth—his being at least fourteen years of age and not over seventeen years, and his having no infirmity that disables him for marine duty.

The requirements for admission are a knowledge of arithmetic, algebra, geometry, plane trigonometry, applied mathematics, natural philosophy, chemistry, geography, the English language, drawing. The candidates must prepare a composition in French, a translation from Latin, an exercise in English, a numeral calculation in trigonometry, a geometrical drawing, and an off-hand sketch of a head. There are two oral examinations on the above studies, the second of which is not attempted if the first, which is elementary, is unsatisfactory.

The commander of the *Borda* is a full captain, and the instruction, which is practical as well as theoretical, is confided to eleven



professors, of whom five belong to the hydrographic department, eight are full lieutenants, and one a principal engineer. The duties of the five hydrographic professors are thus divided:—Two teach astronomy and navigation, two analytical and mechanical science, and the last natural philosophy and chemistry. The duties of the other professors are thus arranged:—Two for literature, history and geography; two for the English language; and two for drawing. The lieutenants direct four courses of instruction, namely, naval architecture, the theory and practice of managing a ship, gunnery and small arms, with practice, and nautical calculations. The engineer professor teaches the theory and management of steam-engines and mechanics. The other officers are a captain of a frigate, (second in command,) a chaplain, a financial and an administrative officer, and two medical men. Besides these, there is a captain of gunnery and several under-officers of the marine and artillery.

The school sessions commence on the first of October, and on that day promotions of the pupils are made in the various classes. Those who have passed two years of study in the ship are called *grand ancients*, rank with naval aspirants of the second class, and are eligible to make a voyage of circumnavigation in another vessel appropriated to that purpose; pupils who have been one full year in the *Borda* are called ancients, and the rest new boys, or in French naval language, *fistots*. The boys have each a number, and in all the ordinary routine of the school-ship, this takes the place of a name.

The elder pupils are employed as monitors over the younger, and each of the former has one or more allotted to him, not as a fag, but as a scholar, whom it is his duty to teach all he himself knows. It is said that the system succeeds admirably, and that for the first few months the instruction of the new comer is left almost entirely to his *ancient*; the new pupil thus escapes without difficulty many errors of discipline into which he would otherwise inevitably fall.

The discipline of the school is severe; the boys rise every morning, all the year round, at five o'clock, stow away the hammocks in which they sleep, attend prayers, and then commence their morning's work.

They are well fed, having coffee or chocolate in the morning, dinner (old style) at 12 o'clock, a lunch of bread (*gôûter*) at 4.30, and supper at 7.45, with bread *à discrétion*, and about four-tenths of a pint of wine at each of the two principal meals.

The morning studies are devoted to science; those of noon to practice with guns, or practical study, marine machinery, or draw-



ing; and the evening to literature, the English language, or naval architecture. All the studies are pursued on board, with the exception of natural philosophy and chemistry, the professor of which has at his command in the town the collection of instruments and chemicals, as well as the lecture-room and laboratory of the central pharmaceutical establishment. At times, also, the pupils are taken to visit the vessels in process of construction, and the workshops in the arsenal, and to practice with small arms on shore.

There are eight boats attached to the *Borda*, and the pupils are practiced almost every day, and in all weathers, in rowing and sailing, under the eye of an officer, who watches the exercises from on board a small steam-gunboat attached to the school. The ordinary studies of the school end between six and seven in the evening, and the pupils turn in at nine o'clock for their eight hours' rest.

Thursday and Sunday, as usual in France, are exceptional days, when, after nautical calculations, (which are never omitted,) the elder pupils or ancients practice with small arms on shore, and the juniors are drilled in the use of the sword, musket, and bayonet. After this they have six hours' hard work in maneuvering two small corvettes, provided for the purpose, that belonging to the ancients being a screw-steamer.

The boys, as a rule, are at liberty on alternate Sundays, and the most advanced every Sunday afternoon. This is a recent innovation; the pupils used to be free scarcely more than once a month; but this gave rise to much discontent and some disturbance, and the rule has, therefore, been made less severe. In addition to this liberty, however, all the lads are allowed to see their friends for a short period during the exercises on shore on Sunday and Thursday mornings, and those who are not free on Sunday are taken on shore for a change in the afternoon. During the summer months the boys bathe in the sea.

A peculiar custom exists in the school—the boys are allowed to smoke during the hour of recreation after dinner, and at certain other times; and for this reason, that as it was found utterly impossible to stop the practice entirely, it was deemed better to recognize it in moderation, and thus stop its secret indulgence and the attendant danger of fire.

The punishments inflicted in the school are extra drill and confinement, either in a small cell or in a dark hole, with a regimen of bread and water; for very grave offences, boys are dismissed or expelled. On the other hand, the marks for good conduct are numerous; there are several examinations in the various classes during



the nine months of the school year, and those pupils who gain the greatest number of marks are called *élèves d'élite*, and wear a gold anchor on their collars, or, in the case of the first twelve, two anchors; the pupil who has gained the largest number of marks bears the high but merely nominal rank of first brigadier, and he who enters the school with the greatest success at the examination is called major. A general examination takes place at the end of the year, when the ancients who pass become aspirants in the navy, and the juniors are raised to the upper class in the school; those who fail in the examination are either sent back to their class, or rejected as unfit for the naval career. The first and second prizemen, on quitting the school, receive each a quadrant in the name of the Emperor, and the third a telescope.

The elder pupils have nearly three months' holiday, but the junior pass a month on board another vessel, the *Bougainville*, for what is called the summer campaign. This vessel, which was constructed specially for the school, is a screw dispatch-boat with engines of 120 horse power; the summer voyage is settled by the Minister of Marine, and includes a visit and examination of the ports of L'Orient and Cherbourg, touching at some remarkable points of the French coast, sometimes casting anchor off the English coast, and sometimes running as far as Ferrol in Galicia.

The *grand ancients*, when their holidays are over, that is to say on the first of October, join the *Jean Bart*, which makes an annual voyage of several months' duration. This boat was built in 1852 and made its first voyage of this kind in 1864-5. She is an 80-gun ship, of the mixed class, having engines of 450 nominal horse-power. In August of the present year she will have completed her fourth and last voyage of circumnavigation, another vessel, the *Donawert*, now being prepared to succeed her. The upper gun-deck of the *Jean Bart* is disarmed, and converted for the use of a part of the officers and the pupils, who number about a hundred, and occupy eight cabins, each with two portholes; here the young men eat, and drink, and sleep, as well as pursue their studies.

The officers of the *Jean Bart* consist of a full captain in command, a second captain, a chaplain, ten lieutenants, one having charge of each pupil's cabin, or *poste*, as it is called, and two giving instruction in sailing and gunnery; a surgeon-major, who gives instructions respecting the means of keeping a crew in health; two assistant-surgeons, an engineer, a drawing-master, and some others.

The Minister, as in the case of the summer cruise of junior pupils, settles the course to be taken by the *Jean Bart*. Generally

the West India islands are visited in the months of March and April, when the pupils are principally exercised in hydrographical works off St. Pierre and Fort de France; in gunnery on board, and small-arms on shore; in the daily management of boats for embarkation and disembarkation; and in the management of sails in the intricate channels of the archipelago. They are shown, moreover, how to perform difficult operations, such as the unshipping of the rudder and bringing it on deck for examination, lifting a mast, &c. The pupils are required to keep written records of all such operations, and to illustrate the narrative when necessary with drawings. When they visit foreign yards and arsenals, they are expected to give minute accounts of what they have seen there, and besides a daily journal, to write critical notices of all the different machines, methods of rigging, and maneuvers, which they have witnessed.

The difficult channel of the Isle St. Sebastian, off the coast of Brazil, that of the Bermudas, the river Hudson, and the coast of Newfoundland, are among the places selected to initiate the pupils in the difficulties of navigation. At Annapolis, in the Chesapeake, a visit is paid to the National Naval School of the United States at the season when the general examinations take place in that establishment. The voyage usually terminates with a visit to Cape Breton and some points of Newfoundland; the fisheries and drying-houses of St. Pierre and Miquelon are generally visited, and the *Jean Bart* returns to Brest between the 1st and 5th of August, having been absent ten months. A sailing brig named the *Obligado* has lately been attached to the *Jean Bart* as a supplementary vessel.

#### SCHOOL OF NAVAL ARCHITECTURE AT PARIS.

The construction of ships and engines in the French naval service is intrusted to the Corps of Marine Engineering, (*Corps du Génie Maritime*), consisting of 121 officers, viz., 1 inspector-general, 10 directors of naval construction, 40 marine engineers, and 70 assistant engineers.

This corps is recruited from the graduates of the Polytechnic, and having passed satisfactorily the required examination for the public service, are sent to the School of Application of Naval Engineering at Paris, and to the dockyards, to learn their special business. The usual number in attendance is 30, and the annual cost of the school is about 100,000 francs.

The course occupies two years and a-half—three winters in Paris



and two summers in the dockyards. The pupils having a good general education and a complete special knowledge of mathematics and geometrical drawing, the courses are from the start eminently practical.

The instruction in Paris during the first session consists of: 1, a course on construction; 2, on displacement and stability; 3, on strength of materials; 4, English; 5, free-hand drawing; 6, plan-drawing of vessels. During the second session it consists of: 1, a practical course on steam-engines; 2, a theoretical course on steam; 3, applied mechanics, machines in general; 4, English; 5, accounts; 6, plan-drawing, ships and engines; 7, pictorial drawing. During the third session: 1, course on stability, (2d part;) 2, on naval architecture; 3, naval artillery; 4, technology of workshops special to the navy; 5, accounts; 6, English; 7, plan-drawing, projects for ships; 8, free-hand drawing.

In the first year ship-building is taken up; in the second, the steam-engine, and in the third the two are combined and completed. When in the dockyards, the pupils are placed under the order of the engineer in charge of works in execution, who sees that they are attentive to their duty, and have proper instruction. He also examines and certifies the journals which the pupils have to keep. The director of the school gives each pupil detailed instruction to guide him in the choice of the practical work he shall attend to. The first summer is devoted to the construction of ships, the second to that of engines. The pupils select the ports to which they will go, according to their standing in their class.

At the end of two years and a-half, the pupils are examined by a board, and if found qualified, they are appointed assistant engineers of the third class. If they fail to pass, they may be allowed another year—but failing in that, they are definitely rejected.

The private pupils, natives or foreigners, who to the number of eight are allowed to attend the course in Paris, may obtain permission to go through the whole practical course in one of the imperial dockyards, but are not subjected to the same discipline as the regular pupils. On leaving, they receive from the director a certificate of the course gone through, their talent and diligence.

The school is under the immediate orders of a Director of Naval Construction, who is also one of the professors, and is assisted in the several branches taught by other professors, who are marine engineers, and a special teacher of drawing, and another of the English language.

## MARITIME CONSCRIPTION.

The French naval service is supplied by a system of conscription analogous to that for the army. All persons, who reside on the coast, whose labor is on the sea, or on navigable rivers reached by the tide, are enrolled on arriving at the age of eighteen, and are liable to be summoned to the naval service until they are fifty, for an aggregate period of seven years.

## SCHOOLS OF MARINE ARTILLERY.

There is at Brest, Toulon, and L'Orient, schools of marine artillery, besides floating schools at Brest and Toulon, for practice at firing at a mark at sea.

## BOARD OF HYDROGRAPHERS.

The Board of Hydrographers is located at Paris. Pupils who have completed the polytechnic course enter the corps with the rank of *élève hydrographe*, with the same rank and advantages as naval architects. They are sent to the coast to make surveys, and after two years service in the field, and in office work under special instruction, become assistant hydrographers without further examination.



## NEW LABORATORIES AND FACILITIES OF PRACTICAL SCIENCE.

The example of Prussia in enlarging and equipping with every new appliance of original investigation, the chemical laboratories at Berlin and Bonn, has already been followed with similar improvements and enlargements in France. The Minister of Public Instruction, in his report for 1868, states, "that while the laboratories of instruction in the Museum of Natural history, the Sorbonne, and the School of Medicine, are receiving improvements and enlargements, means have been obtained from the *Corps Legislatif* to establish new laboratories of research—those arsenals of science, which will assure the perpetuity of scientific progress, around which professors of renown will gather a limited number of pupils, well grounded in theoretical knowledge, and accustomed to the use of instruments and elementary manipulation, who will practice under direction and example, the art of observation and the method of experimentation." The essential and novel condition of these laboratories, will be that the professors in charge will have entire liberty to carry on their own labors, as well as the studies of their pupils, without reference to any official programme as they may believe most advantageous to science and the arts.

## NEW PRACTICAL SCHOOL OF HIGHER STUDIES.

The crowning feature of this new movement is the establishment of a new practical school (*l'Ecole pratique des Hautes Etudes*,) of science. The instruction is not limited to chemistry, as its connection with the new laboratories might imply, while the new and enlarged laboratories are to be open for instruction, manipulation, and practical experiment to pupils of the new school. The school itself is divided into four sections: 1. Mathematics; 2. Natural Philosophy and History; 3. Natural History and Physiology; 4. Historical study and Philological Science.

No condition, with respect to age, grade or nationality is prescribed, but all candidates must go through a probationary stage of three months or more, when they will be classified by the director assisted by a permanent commission.

The pupils are not to be gathered into a separate establishment either for residence or instruction, but will be grouped into the special schools, which are to be developed in connection with existing educational establishments.

The pupils of the mathematical section will be admitted to courses at the observatory where they will be initiated into the theoretical knowledge that astronomical mathematics demand, as well as in the use of all the instruments employed, thus forming a veritable school of astronomy.

The pupils in the section of historical and philological science will not only study the literature and general history of antiquity, the middle ages, and modern times, but their course will embrace archæology, the science of language, paleography, comparative and general grammar, criticism of history, &c.

The students of natural history will find in the enlarged and re-equipped laboratories of the Museum of Natural History, every facility of direction, instruction and experimentation for the study of animal and vegetable production, which the most advanced school of agriculture could give, and which the most curious and zealous agriculturalist could desire.

A grand director is to be appointed by the Emperor, on the nomination of the Minister of Public Instruction, and in the same way a special director for each section and for each laboratory.



The report submitted to the Emperor, July 31, 1868, briefly enumerates the reasons which have led to the establishment of this new practical school of higher studies (*école pratique des hautes études*), and enumerates the places where and under whose auspices the instruction is given.

The main object has been to unite the pupils of our great schools who prepare themselves for the licentiate degree, or who show a decided vocation and special scientific aptitude, in order to give them not only the benefit of the general teaching of the faculty they have chosen, but also the special counsels of the best authorized professors of the country and the means of testing the theory by practice at any time or to make personal researches on any scientific question. Professors of tried knowledge are constantly ready to supplement the regular teacher and to render, to a certain degree, his instruction constant.

The superior council held its first session, Nov. 3, 1868, and special committees appointed by the Minister of Public Instruction examined the candidates. Of these there were 342. The total number of those who registered their names for examination was 422, divided among the following four sections: mathematics, physics and chemistry, natural sciences, history and philology. The examination has reduced the original list somewhat, but new names are registered every day. For the two sections of chemistry and natural sciences, 27 laboratories have been prepared for instruction and researches, and 265 students work there regularly from day to day. The following is the distribution of work in the different sections.\*

#### I. THE SECTIONS OF PHYSICS AND CHEMISTRY AND OF NATURAL SCIENCES.

##### LABORATORIES FOR INSTRUCTION.

##### *Physics.*

The laboratory instituted in the faculty of sciences, opened Dec. 15—Prof. Desains. The students are instructed in the handling of physical instruments, and go through a series of classical experiments relating to heat, light, electricity, magnetism, and acoustics. *Hours of study*: Monday, Wednesday, Thursday, and Friday, from 9 to 11.

##### *Chemistry.*

The laboratory of the *Collège de France*, opened Dec. 10—Prof. Balard. The students make general chemical experiments and practice analytical chemistry. *Hours of study*: Every week-day from 11 to 5.

The laboratory of the Museum of Natural History, opened Dec. 1—Prof. Frémy. General chemical experiments and qualitative and quantitative analysis. *Hours of study*: Tuesday, Thursday, and Saturday, from 11 to 5.

The laboratory of the Faculty of Sciences, opened January 11—Prof. St. Claire Deville. Experiments in organic chemistry applied to physiology; 4 hours each per week.

##### *Mineralogy.*

The laboratory of the Faculty of Sciences, opened Dec. 12—Prof. Delafosse. The students practice determining mineral specimens and crystalline forms by means of the soldering-pipe, recipiangle, and polarization apparatus. *Hours of study*: from 2.30 to 4.30 (Thursday.)

##### *Geology.*

The laboratory of the Faculty of Sciences, opened Nov. 30—Prof. Hébert. The students practice determining specimens of rock and characteristic fossils from the different geological strata. *Hours of study*: Thursday, from 1.30 to 3.30.

##### *Botany.*

The laboratory of the Museum of Natural History, opened in April—Professors Brogniart and Decaisne. The studies consist chiefly in dissecting plants, in microscopic observations, and various other processes employed in the study

\* Exposé de la situation de l'Empire, 1869.



of the anatomy and physiology of plants, analysis of original essays, &c.; in collecting plants, and scientific conferences devoted to the arranging and classifying of the plants collected by each student.

The laboratory of the Faculty of Sciences, opened in March—Prof. Duchartre. The students practice microscopic exercises and analytical anatomy of plants.

The laboratory of the Faculty of Medicine, opened Dec. 14—Prof. Baillon. The pupils practice anatomical manipulations and observations; during summer, weekly botanical excursions, followed by conferences. *Hours of study*: Every day, from 12 to 4.

#### *Anatomical and Physiological Zoölogy.*

The laboratory of the Museum of Natural History, opened Dec. 2—Prof. Milne Edwards. The studies consist in:—1, Microscopic observations, dissecting experiments, &c., arranged in such a manner as to make the students thoroughly acquainted with a series of animals representing the principal geological types, and the mode of action of their various organs; 2, in exercises relating to the determining of the zoölogical character and the way of employing the methods of classification; 3, in graphic exercises, description of anatomical specimens, analysis of original essays, &c. *Hours of study*: Every day, from 11 to 2. Every Thursday, at 7.30 P. M., scientific conference.

#### *Histology.*

Exercises relating to the employment of the microscope for the study of the internal structure of the constitutive tissue of animals, are held at the laboratory of Prof. Milne Edwards at the museum, under the direction of Prof. Robin, every Monday, Wednesday, and Friday, at 8 P. M.

#### *Physiology.*

The laboratory of the Faculty of Sciences, opened Dec. 25—Prof. Bert. Repetition and classical experiments in physiology.

#### LABORATORIES FOR RESEARCH.

Students who are qualified for scientific investigations are admitted to the following laboratories:

The laboratory of physics at the Faculty of Sciences—Prof. Jamin.

The laboratory of mineralogical chemistry at the *Collège de France*—Prof. Balard.

The laboratory of organic chemistry at the *Collège de France*—Prof. Berthelot.

The laboratory of general chemistry at the Museum of Natural History—Prof. Frémy.

The laboratory of mineralogical chemistry at the Superior Normal School—Prof. St. Claire Deville.

The chemical laboratory at the Faculty of Medicine—Prof. Wurtz.

The geological laboratory at the Faculty of Sciences—Prof. Hébert.

The laboratory of the natural history of inorganic bodies at the *Collège de France*—Professors Elie de Beaumont and St. Clair Deville.

The botanical laboratory at the Museum of Natural History—Profs. Brogniart and Decaisne.

The laboratory of general physiology at the Museum—Prof. Claude Bernard.

The zoölogical laboratory at the Museum of Natural History—Prof. Milne Edwards.

The laboratory of comparative anatomy at the Museum of Natural History—Prof. Gervais.

The laboratory of histology at the Faculty of Medicine—Prof. Robin.

The laboratory of experimental medicine at the *Collège de France*—Prof. Claude Bernard.

The special laboratory of experimental physiology of Dr. Marey.

A lecture-hall for the use of the students of the physico-chemical section at the Faculty of Sciences, open every day from 10 to 4.

## II. THE SECTION OF MATHEMATICS.

*Directors.*—Messrs. J. Bertrand, Briot, Delaunay, Serret, Puiseux, professors of the Paris Faculty of Sciences. *Répétiteur.*—Dr. Didon.

The pupils of this section who have been licensed, can be admitted to the mathematical course of the Superior Normal School. A hall for studies and conferences is reserved for their use at this school, and the scientific library is open for them.

## III. THE SECTION OF HISTORY AND PHILOLOGY.

*History.*

*Director of Studies.*—Alfred Maury, professor of history and morals at the *Collège de France*.

*Répétiteurs.*—Monod and Rambeau, of the Normal Superior School.

*Egyptian Philology and Archæology.*

*Director.*—De Rouget, professor at the *Collège de France*.

*Greek Philology, Greek and Oriental Archæology.*

*Director.*—Waddington, member of the Institute.

*Répétiteur.*—Tournier, who gives a supplementary course of lectures on Greek literature.

*Roman Antiquities.*

*Director.*—Léon Renier, professor at the *Collège de France*.

*Répétiteur.*—Dr. Morel.

*Latin Philology.*

*Director.*—Boissier, professor at the *Collège de France* and the Superior Normal School.

*Répétiteur.*—Dr. Morel.

*Comparative Philology.*

*Director.*—Bréal, professor at the *Collège de France*.

*Répétiteur for Sanscrit.*—Hanvette-Besnault; assistant *répétiteur*, Berguigne.

*Répétiteur for the Semitic languages.*—Guyard, assistant librarian of the Asiatic Society.

*Répétiteur for the Romanic languages.*—Dr. Gaston Paris.

A hall for lectures and conferences is at the disposal of the students, in the library of the Sorbonne.

Students of the historical section who have been licensed, can be admitted to the course of history at the Superior Normal School.

The establishment of a fifth section (of economical sciences) is contemplated. It is not intended to confine the practical school of higher studies to Paris, but steps have been taken to establish laboratories at an early date in the larger provincial towns.



## INDUSTRIAL ART MUSEUMS.

There is in France no specific Museum of Ornamental Manufactures, although one is now projected by the *Union Centrale des Beaux-Arts appliqués à l'Industrie*, but there are a number of collections which are made useful in teaching and studying the various manufactures involving artistic ornamentation, and in increasing a feeling and appreciation of art-workmanship. Of these, we notice briefly the principal ones.

1. *Collection of Marbles and Plasters at the Ecole des Beaux Arts.*—This collection originated in the purchase by the government, in 1828, of the ornamental specimens collected in Rome by M. Dufourny, an architect of the latter part of the last century. It now includes many casts of architectural objects, illustrating nearly all the renowned temples of Greece and Rome, arranged in accordance with exact measurements obtained at great expense. Among these may be mentioned large portions of the Parthenon, the Erechtheium, the façade of the Pandrosium complete, the choragic monument of Lysicrates complete, and great capitals and entablatures complete from many of the Roman temples. There is a large portion of the Arch of Titus. The façade of the Château de Gaillon has been transported hither from Normandy. Besides, in M. Dufourny's collection were many fragments of ancient marbles. The cost was originally about £2,000, but it is now considered worth £20,000.

2. *Collection at the Conservatoire des Arts et Métiers.*—This institution is intended to encourage the growth of the mechanical arts and trades, and lectures are given there upon geometry, mechanics, physics, chemistry, agriculture and political economy, and lessons in mechanical drawing, to a large and growing class. It has a library of 15,000 books on the industrial arts, a vast collection of machinery, and a *Salle de Portefeuille*, with about 12,000 drawings of machinery and 20,000 brevets of inventions, all freely accessible to the public at all times, for the purpose of making drawings or tracing. There are two lecture-rooms, one of which will accommodate 1,200 visitors, the other 250.

3. *Collections in the Louvre.*—In the Louvre, besides the famous gallery of paintings, too well known to need description, there are distinct museums of marbles, plasters, paintings, drawings, prints, enamels, pottery, glass, bronzes, naval and other curiosities and antiquities.

The collection of casts is not large, nor is that of marbles and antiques. There are in this very few specimens of ornamental art.

The museum of enamels is a mixed collection of objects of all kinds, decorated with painters' and jewelers' work of this sort, with an excellent catalogue, constituting a valuable history of the whole subject. Among the articles are many illustrating other arts besides that of enameling.

The *Musée de la Renaissance* was begun as early as the beginning of the 16th century, and contains, in five apartments, specimens of French sculpture, more particularly of figures and ornaments, plate and jewelry being considered of minor importance. The five apartments are named after five sculptors—Francheville, Anguiers, Jean Goujon, Jean de Douay, and Michel Colombe, and contain the works of these and other distinguished Frenchmen.

The *Musée de la Marine* is a valuable collection of various objects connected with ship-building, navigation; &c., such as models of various vessels and ma-

chines, relief-plans and drawings of harbors, ports and piers, fire-arms, scientific instruments, sextants, and relics connected with French naval history. One room is filled with curiosities from the East, captured in various expeditions, forming the foundation of an ethnographical museum.

We will merely mention the following collections: Antiquities from Assyria, Asia Minor, Egypt, Algeria, and America; engravings; antique terracottas containing 12,000 specimens, mostly from Etruscan tombs, many cinerary urns among them; a very extensive and valuable collection of drawings.

4. *Museum of the Hôtel de Clugny*.—"This is the nearest collection to a museum of ornamental manufactures in France." It was first formed by M. de Sommerard, and opened to the public in 1843. It is essentially, however, a historical museum, and the arrangement was planned with a view to this. It contains nearly 3,000 objects or groups of objects of sculpture in all materials, painting, glass painting, enamels, pottery, glass, jewelry, clock-work, locks, arms and armor, weapons used in the chase, engraved and chased iron-work, tapestry, embroidery, church ornaments, mosaics, bronze, &c., the greater part belonging to the sixteenth century. In the garden are many fragments of mediæval architecture.

In the old hall of the Roman baths, in the back court of the building, are the scanty remains of the Roman period found in Paris.

5. The *Musée Céramique* is connected with the porcelain manufactory at Sèvres, not far from Paris. It contains some thousands of objects illustrating the history and art of ceramic manufacture, the various classes comprehending articles in pottery and porcelain, glass, painted glass and enamel. There is a nearly complete set of plaster casts of the best productions of the manufactory, copies of these casts being for sale. "The arrangement is purely scientific, illustrating the physical development of the art, the nature and order of discovery of pastes and glazes." The orders and sub-orders are classified geographically and chronologically.

The collection was commenced by M. Brogniart in 1800, and is now valued at 500,000 francs, although having been acquired by exchange it has not cost more than one-tenth of that sum.

6. *Musée d'Artillerie*.—This museum, connected with the *Dépôt Centrale d'Artillerie*, contains about 4,000 objects illustrating the science of artillery, mostly weapons, many of them of historical interest.

7. The *Museum of Natural History* at the *Jardin des Plantes* is very valuable and extensive, and needs no special notice in this place.

8. The *Gobelins* contains, in the exhibition-rooms connected with it, a small number of tapestries of its own manufacture, designed chiefly after celebrated pictures.

9. *Collections at Lyons and Rouen*.—In the Museum of Antiquities at Lyons are casts, bronzes, and a good collection of ancient glass. At Rouen, in several collections, are casts, architectural models, pictures, and an archæological museum, called the Norman Museum.

Since the above sketch of existing Museums of Art was in type, we have received additional information of the progress of the *Union Centrale* in establishing a Museum on the plan of the South Kensington Museum, London.



## UNION CENTRALE.

The *Union Centrale* of the Fine Arts applied to Industry, instituted in 1862, is vigorously prosecuting the following objects: 1. The establishment of a permanent Museum of Industrial Art, with a hall and class-rooms for evening lectures and courses for artisans and designers; 2. An annual exhibition of the products of the workshops and art-schools of France, with prizes for artistic excellence in form, color, and adaptation; 3. A library of publications on art and art manufacture. The annual exhibition in 1866 was attended by 215,000 visitors, and the profits of \$20,000 were applied to the museum and library. At the distribution of prizes in 1867, the Minister of Public Instruction presided, and addressed the members and visitors on "the necessity of illuminating and enriching the thoughts and aspirations of the workingman, be he called artist or artizan, as well as training his hand to greater skill." In another address, the same minister (M. Duruy) cites the example of Switzerland in giving a good general education to all classes, and special scientific training to all workingmen, as worthy of the imitation of France.

## INTERNATIONAL CONFERENCE ON ART EDUCATION.

Under the auspices and in the council-room of the *Union Centrale*, a conference was held at the close of the annual exhibition of art applied to industries, in 1869, in which eminent professors and artists from Brussels, London, Vienna, Stuttgart, Munich, Nuremberg, Berlin, and other cities, participated. The following conclusions were reached:

*First.*—Of the character and conditions of modern productions in industrial art, the congress is of opinion:—(1.) That the dominant artistic character of contemporary production is essentially unsettled, on account of ill-advised over-production. (2.) That the necessity for the production of large quantities of articles, in great variety, and at low prices, from the introduction of machinery and division of labor, is, in general, in contradiction to the true sentiment of art in the objects produced. Also, 1. That an exaggerated value is attributed to organization, to the detriment of individual action. 2. That apparent material perfection, and the admiration for details, are sought for, to the detriment of general harmony. 3. That the discoveries of science are often applied without sufficient comprehension.

*Second.*—Of public taste and its influence on production, and the means of developing and improving it, the congress considers that public taste is the reflection of the intellectual and moral condition of society, and that the principal causes of its insufficiency and fickleness are:—1. The tendency to make the sentiment of art subordinate to the material perfection of workmanship; and 2. The general tendency towards apparent rather than real qualities. These causes united necessarily exercise a deplorable influence on production, and the congress is of opinion that the only mode of remedying such a state of things is the introduction of a new, general, and complete system of education in matters of art, which shall propagate the soundest notions in all classes of society.

*Third.*—Of the actual organization, and of the development to be given to the study of the arts of design; of the direction of such study; of professors, of methods, and of examples or copies; the congress is of opinion that the actual organization of such instruction is not on a level with the wants of the age, because:—1. The examples which tradition furnishes are not sufficiently known, and generally badly interpreted—their spirit is misunderstood for want of education. 2. The study of nature is generally insufficient and ill-directed.

The congress declares:—1. That preparatory instruction in drawing should be introduced in primary education. 2. That the development of the sentiment of art should be commenced in early youth, by the beautiful in all its forms being daily presented to the child's eye. 3. That greater and entirely new im-



portance should be given to museums of instruction in villages as well as in towns. The congress is of opinion that instruction in drawing should form a part of the obligatory programme of primary instruction. It desires to express its profound conviction that in art-education there should be no division; that the unity of art should be the only law and principle of instruction.

*Primary Instruction.*

The congress can not recognize the present principle of primary instruction, which is limited to the servile and textual imitation of copies. It is of opinion that the pupils in the common schools should, from the very outset, have placed before them those elementary geometric models which constitute the alphabet of form, as well as the simplest common objects, with the indispensable aid of the teachers' oral explanations.

*Secondary Instruction.*

The congress finds the present system of secondary instruction objectionable, on account of the abuse which is made of drawing copies; and it declares it to be its opinion that intellectual interpretation (the reduction or amplification of the model or copy,) reproduction from memory, and choice of the models of execution, should take the place of literal and servile copying.

*Professional Instruction.*

With respect to professional instruction, the congress expresses a desire that in the schools general instruction in art should take the place of any industrial application to meet a special demand. It can not but regard all premature workmanship as dangerous to art, and injurious to the pupil's future career.

*Professors for Normal Schools.*

The congress recommends the extension of instruction in drawing in the Normal schools for primary teachers, under special professors; and for this purpose that a superior normal school for training such professors be established.

*Methods, Models, and Copies.*

The congress does not recommend nor prescribe any particular method, except to guard against and discourage all those in which the employment of mechanical and abbreviated processes dispenses with the direct, personal, and attentive observation of the pupil.

The employment of printed copies, which possess the serious fault of substituting the study of picturesque effect, which is but an accidental character, for that of form, which is a permanent one, is condemned.

*Fourth.*—On a comparative examination of the experiments tried in various countries to further the progress of industrial art, the development of public taste, and the improvement of instruction in the arts of design, the congress recognizes with satisfaction:—1. That during the last few years there has been an awakening of public opinion which directed civilized nations towards the extension and progress of art industries, the improvement and generalization of instruction in the arts of design, and the development of a taste inseparable from an action favorable to morality. 2. That under the influence of this excellent spirit, efforts have been constantly made by governments, societies, and individuals, which have already given rise to the creation of important institutions—schools, societies, museums, &c.

The congress is of opinion:—1. That it is important to give effect to the proposition made at the time of the Universal Exhibition of 1867, that each country should cause copies of the artistic objects in its possession, and endeavor, by all possible means, to make them known and used in other countries. 2. That serious endeavors be made to improve the condition of professors devoted to instruction in the arts of design, because upon that condition depends essentially the quality of such instruction.

A committee of the *Union* is charged with the mission of calling the attention of the proper authorities to the suggestions and recommendations of this conference.



Mr. E. A. Davidson, in a paper on Industrial and Scientific Education as exemplified in the Paris Exposition of 1867, gives the following as the substance of the instruction in drawing in special schools for industrial purposes.

*First Course.*—Practical plane geometry, elementary free-hand drawing, flat tinting with pen and brush, elementary coloring, solid geometry, perspective, model drawing, and projection of rectangular objects to a given scale.

*Second Course.*—Advanced practical geometry—embracing the higher curves and figures used in machinery and architecture—such as the conic sections, the cycloid, the epicycloid, the helix, conchoid, cissoid, spiral, &c., orthographic and geometrical projection, penetrations and sections of solids, development of surfaces, and the projection of shadows, advanced perspective, free-hand and model drawing and shading.

*Third Course.*—Machine-drawing—including the construction of the teeth of wheels, screws, &c., from blackboard lessons; rough sketches, and actual measurement to scale and given data; tinting and broad shading. Building construction, practical and historic architecture, ornamental and architectural drawing. Construction of technical working-drawings to scale, adapted for the various branches of industry.

The same paper gives, with marked approbation, the following example of the aids of mechanical drawing at the Institute of the Christian Brothers in Paris.

*Aids of Scientific Drawing in the Schools of the Christian Brothers.*

This system, designed by Frère Victoris, the professor in the *Institute des Frères des Ecoles Chrésiennes* in Paris, received the gold medal of the Exposition of 1867. The whole scheme embraces the following helps:

(1) Text-books for the pupil and others for the teacher, adapted to each of the two years over which the course extends.

(2) Large diagrams, for schools where the class is so numerous that the master can not spare time to work out the lesson on the blackboard.

(3) Models, which are still further developed by Frère Victoris, by the addition of a plane at right angles to the other two; this third plane, on which the side or end elevation is projected, moves on hinges; and as the lines are made to work into each other, the paper which covers the planes will, when laid out flat, show how the heights and widths have been obtained from the object. Amongst the models is a niche under a pediment in plaster of Paris, which is cut vertically and horizontally so as to show sections of the niche, cornice, and pedestal, and is a good study for artistic as well as for scientific drawing. The other models comprise several arches and staircases, with movable parts, three large planes with objects, such as capitals of orders, cornices, &c., to be used as studies for the projection of shadows; also numerous roof timbers, not merely as trusses, but as portions of roofs showing the whole assemblage of timbers. These, if reproduced on a larger scale, would be of the greatest use to our science teachers. The set also comprises columns and entablatures of the orders of architecture made of hard wood; these divide so as to exhibit the entasis of the columns and numerous sections of capital, cornice and base, all the parts fitting together in the most exquisite manner.

There are also wooden cornices made up of various moldings, which, being open at the ends, show how the members are made up. The models above mentioned are but types of the whole system.

The Institute above referred to is a Normal School for training teachers, and has connected with it an asylum for the aged and infirm members of the order, who are employed all over France.



## TECHNICAL EDUCATION OF GIRLS.

In 1854, the Vicomtesse D'Anglais, with a view of assisting young women respectably born and educated, but left destitute and dependent upon their own exertions for a livelihood, founded an institution in Paris entitled *Notre Dame des Arts*, aided by several sisters of a religious order.

The institution proper is a boarding school, and receives the orphans of literary men and artists, who alone compete for the scholarships with which the school is endowed. Other pupils are admitted, however, on payment, on the same footing as the orphans, but can not compete for the scholarships. The endowments for scholarships are furnished by grants from the Minister of Public Instruction, the General Council of the Department of the same, and the Municipal Council of Paris. In addition to the subjects of a general education, particular attention is paid to the teaching of music and the decorative arts. This last includes designing patterns for tapestry, for church ornaments, jewelry, painting on porcelain or enamel, on glass and church windows, painting in oil and water-colors, crayons, drawing and painting on ivory, lithography, engraving on wood and steel, embroidery in general, making of church vestments and artificial flowers. The productions of the scholars are sold for the benefit of the pupils. The number of pupils in 1868 was 140, and the school was managed by eighteen ladies and sisters, whose instructions are gratuitous.

At Nantes there is a manufactory of stained glass connected with a congregation of Carmelites, which has already attained high reputation, and provided beautiful windows for various churches in Paris and elsewhere. The sisters began by painting banners used in church processions, and there being occasion to put new windows into a building of the Order, they employed their talents and taste in designing and fabricating stained glass, and by continued practice have reached a skill not surpassed in the manufactories of the same kind at Tours and Clermont.

Besides the Special School of Drawing for Young Women in the Rue Dupuytren, in which have been trained very successful designers and artists for manufactures in ivory, porcelain, and book-work, instruction is now given in drawing and modeling in a large number of municipal schools in Paris, open to women as well as men.

The experience of the last few years has demonstrated clearly that in the whole field of plastic art, all labor which deals with forms and the representations of forms, from the highest ideal to the most familiar details of ordinary life, can be opened to woman properly trained in the first and successive steps of modeling and drawing. The most delicate touches on porcelain and ivory, the most exquisite copying in form and color of specimens in botany, the whole field of natural history, and the illumination of title pages, have already been executed by her; and it will not be long before the whole field of design for carpets, shawls, and ribbons, and all textile fabrics, will be occupied by her genius. The pencil and the graver will be as familiar to her as the needle or the pen.

In connection with this subject it may be mentioned that Madame la Baronne Hérald de Pages, a lady who has given great attention to agricultural and philanthropic instruction, was commissioned by the Minister to inspect all the girls' schools in France in which the principles and practice of household economy and gardening were attended to, in addition to the ordinary studies of primary schools.



## SPECIAL INSTRUCTION IN BELGIUM.

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### INTRODUCTION.

THE kingdom of Belgium, on an area of 11,400 English square miles in 1863, had a population of 4,836,566. In 1856, out of a population of 4,529,050, 1,062,115 were engaged in agriculture; 419,037 in mechanical arts, (73,292 in mines and quarries; 56,657 in metals; 5,514 in glass and earthen ware; 86,663 in linen and hempen fabrics; 13,883 in woolen fabrics; 12,352 in cotton; 4,016 in silk; 29,851 in leather; 42,130 in alimentation; 68,995 in apparel; 107,332 in building; 15,883 in furniture and decoration, &c. &c.,) and 106,162 in commercial pursuits.

The total annual expenditure of the government of Belgium in 1864 amounted to 150,943,138 francs, of which sum 4,500,000 francs were expended for public instruction.

The institutions of public instruction are administered by the Minister of the Interior, and embrace:

#### I. *Primary Schools.*—Of these there were in 1864:

3,314 Communal schools, with 4,549 teachers and 354,168 scholars.

620 Private schools, supported partly by the government, with 1,464 teachers and 75,421 scholars.

32 Private schools under government inspection, with 79 teachers and 5,116 scholars.

1,427 Independent private schools, with 2,654 teachers and 98,264 scholars.

33 Boarding-schools under government inspection; 230 independent boarding-schools, together with 887 teachers and 11,892 scholars.

460 Infant-schools, with 666 teachers and 40,000 scholars.

Making a total of 6,116 primary schools, with 10,299 teachers and 584,861 scholars. The total expense for primary instruction in 1863 amounted to 9,392,259 francs, of which sum 2,002,902 were paid by the State, 1,131,389 fr. by the provinces, and the rest by the communes.

#### II. *Secondary Schools.*

10 Athenæums, with 3,177 scholars.

50 Government secondary schools, with 7,576 scholars.

19 Communal and provincial secondary schools subsidized by the government, with 2,801 scholars.

1 Exclusively communal school in two divisions at Brussels, with 500 scholars.

15 *Ecoles patronnés* (schools supported in part by an annual grant from the commune,) with 1,676 scholars.

Altogether 95 secondary schools, supported either entirely or in part by

the State or communes, with 15,730 scholars. Besides these, there are 35 clerical schools, 11 Jesuit schools, and 5 private schools—making a total of 146 secondary schools. The total expense for the secondary schools supported either entirely or in part by public funds, was, in 1864: 2,638,213 francs. Of this sum, 980,431 were paid by the State and province, 1,149,014 by the communes, and 508,768 were raised by school-fees.

III. *Superior Schools*.—There are 4 universities, viz.: 3 Catholic universities, [*Ghent*, with four faculties, (philosophy, law, natural science, medicine,) and 417 students; *Louvain*, also with four faculties and 744 students; *Liege*, with five faculties, (theology in addition to the above named,) and 417 students,] and 1 free or non-governmental university at *Brussels*, with four faculties and 522 students. In *Brussels* there is an academy of sciences in three divisions, (science, literature, and art); an observatory; a museum of natural history, and a museum of antiquities; the royal library, with more than 200,000 volumes and 20,000 manuscripts, and an annual budget of \$12,000. The library at *Ghent* has 60,000 volumes; the one at *Liege* 64,000, and the one at *Louvain* 62,000. There are, besides, 17 city libraries, each with more than 25,000 volumes. There are 13 art-museums. The number of scientific societies in the provinces is very large.

IV. *Special Schools*.

- 1 Superior normal school; 5 primary normal schools.
- 5 Agricultural schools, viz.: 1 State agricultural college at *Gembloux*; 1 State horticultural institution at *Vilvorde*; 1 State forestry institution at *Bouillon*; 1 veterinary institution at *Keuringhem*, besides a large number of primary schools in which agriculture and horticulture are taught.
- 3 Schools of commerce, viz.: 1 superior school at *Antwerp*, besides 12 commercial schools connected with schools of secondary instruction; 3 navigation schools, at *Antwerp*, *Ostend*, and *Nieuport*, with an aggregate of 150 pupils.
- 15 Industrial or technological schools, with 2,293 pupils.
- 68 Workshops, with schools and courses of instruction for apprentices and workmen, having an aggregate attendance of 1,857 pupils.
  - 1 School of arts, manufactures and mines at *Liege*.
  - 1 School of engineering, manufactures and horticulture at *Ghent*.
  - 1 Royal military academy, with 105 pupils; 1 cavalry school; 1 pyrotechnic school; 1 school for soldiers' children; and 10 regimental evening schools.
- 60 Academies and schools of art, with 236 teachers and 10,607 pupils.
  - 1 Institution for the deaf and dumb.
  - 1 Institution for the blind.
  - 3 Conservatories of music.
  - 6 Schools for orphans.
  - 3 Schools for juvenile criminals.



## SYSTEM AND INSTITUTIONS OF SPECIAL INSTRUCTION.

BELGIUM was one of the earliest States, not only to develop the arts of design and ornamentation, in reference to the wants and higher civilization of its wealthier and governing classes, but to extend and encourage in various ways the great interests of agriculture, manufacture, and the mechanic arts, out of which the commerce, wealth, and civilization of nations proceed. It was not, however, till the sharp competitions of international industry, caused by the introduction of labor-saving machinery, as well as higher taste and skill, into the workshops of other nations, threatened her linen weavers and industrial classes generally with utter ruin, that enlightened citizens of different towns united in voluntary associations, and the local and state governments of Belgium combined to establish a thorough system, with numerous and excellent institutions, of technical instruction, varied and adapted to different localities, which have not only arrested the progress of industrial destitution at home, but enabled her manufacturers and artisans to compete again successfully in the markets of the world. These and other special institutions, established at different times, may be classified as follows: I. A National Museum of Industrial Models, Designs, and productions at Brussels, and similar museums in other great centres of mechanical and manufacturing industry. II. Workshops for apprentices, in which instruction is given by intelligent foremen and competent professors in all the theoretical and practical details of certain industries, and particularly of weaving. III. Schools of scientific and practical instruction, under the designation of *Écoles Industrielles*, of which there are now fourteen. IV. Technical Institutions of a higher scientific aim, in which may be included the Superior Institute of Commerce at Antwerp; the higher School of Mines at Hainault, and scientific departments of arts, manufactures, and mines, in the Universities of Liege and Ghent. V. Schools and government appropriations in behalf of agriculture, gardening and forestry. VI. Schools of Commerce and Navigation. VII. Galleries, Academies, and Schools of the Fine Arts, and Special Instruction in Drawing and Music. VIII. Institutions and Associations for the promotion of Science, Literature, and the Arts.

Of several of these classes of institutions we will give a brief survey, together with an account in detail of specimens of the most important institutions, drawn mainly from official documents forwarded to this department through the prompt attention of the U. S. Minister Resident. (Mr. H. S. Sanford) at Brussels, and from the reports of the French and English Commissioners on Technical Education.

## I.—NATIONAL MUSEUM OF INDUSTRY.

The Industrial Museum at Brussels, founded in 1826, and reorganized in 1840, embraces in its operations, (1,) a depository of apparatus for investigations in chemistry and physics, as well as models and machines for construction in every department of the arts; (2,) plans of machinery and construction of all kinds; (3,) a technical library; (4,) a collection of periodicals, projects, and current treatises on the application of science to the industries of nations; (5,) a chemical laboratory, where the analysis to test new inventions can be made; (6,) a school of construction drawing, where candidates who are found competent in preliminary knowledge, particularly in geometry, are instructed for two years in geometrical drawing, and in designing and copying plans and specifications of

machines; (7,) models, drawings and specimens of new furniture and utensils; and, (8,) of any and every production which can improve the taste and skill of workmen and the public generally, who are also reached by courses of free public lectures on physics, chemistry, mechanics, political economy, and physiology, in the winter, from 7.30 to 9 P. M.

The annual expenses of the Museum of Industry amount to about 24,000 francs, and are borne by the state. Its affairs are managed by a government commission.

#### II.—WORKSHOPS AND INSTRUCTIONS FOR APPRENTICES.

The workshops for apprentices in Flanders were first established about 1845, their origin being due to the depression existing in the weaving interests of the country, arising from the introduction of superior machinery in other linen-producing lands. They were intended to teach the use of the new looms to old workmen, and to train new apprentices, and also to encourage the manufacture of other cloths besides linen. There are at present 68 of these; in 1860 there were 82. They work 1,528 looms, and are attended by 1,857 workmen and apprentices. The government granting subsidies only on the condition that the communes furnish the workshops, the latter have provided them, rented or built for the purpose. They have sent out, since their establishment, 27,373 weavers, perfectly skilled in the best methods of the trade.

The period of apprenticeship lasts about a year, and the wages paid vary from 35 centimes a day, (to some of the apprentices,) to 2 fr. 50 cent. to skilled workmen. Five per cent. is deducted from the wages and spent in providing implements for the workmen, to be used at home after the termination of the course. The expenses are borne partly by the communes, partly by the state.

Weaving establishments for women were first established at Courtrai, in 1854; there are now several of these paying daily wages of from 1 fr. 25 c. to 2 fr. 50 c.

The result of this system has been satisfactory, both as to the quality of goods produced and as to the morals and intelligence of those employed.

The apprentices who frequent these shops, at the same time they learn their craft and receive wages for their work, devote at least two hours a day to primary instruction.

#### *Expenses of Workshops for 1861 and 1865.*

Expenses for 1861.	Cont'd by the State.	By Provinces.	By Com- munes and <i>Bureaux de Bienfais- ance.</i>	Total.
West Flanders—Ord'y expenses.....	f28,788.04	f10,726.01	f12,724.61	f52,239.26
East " " .....	13,090.76	7,970.62	2,423.60	23,484.98
Hainault " " .....	538.75	271.25	1,762.00	2,572.00
Grants for apparatus.....	7,220.00	.....	.....	7,220.00
Expenses of inspectors.....	1,863.00	.....	.....	1,863.00
<b>Total.....</b>	<b>51,500.55</b>	<b>18,968.48</b>	<b>16,910.21</b>	<b>87,379.24</b>
<b>Expenses for 1865.</b>				
West Flanders—Ord'y expenses....	36,598.07	15,718.16	17,435.03	69,751.26
East " " .....	9,463.50	4,809.04	3,517.50	17,490.04
Grants for apparatus.....	8,300.00	3,900.00	.....	.....
Expenses of inspectors.....	2,465.60	.....	.....	.....
<b>Total.....</b>	<b>56,827.17</b>	<b>24,127.50</b>	<b>20,952.53</b>	<b>87,241 30</b>



## III.—INDUSTRIAL SCHOOLS.

The present system of scientific and industrial instruction originated in isolated schools established from 1825 to 1852, in the chief centres of industry, by the enterprise and foresight of individual manufacturers, associations of public spirited citizens and communal authorities, to meet the wants of different localities, and finally organized, aided and supervised by the State by general legislation in 1861. They grew out of the necessities of disordered domestic industry, which had been in Belgium confined to the linen trade, and which had been superseded in the markets of the world by the introduction of superior mechanism and more artistic designs in other countries.

The general course of instruction common to all the industrial schools comprises mathematics and mechanics, in so far as they bear upon industrial science; linear and ornamental drawing, physics, general and practical chemistry, varying in each school according to the industries which it is more especially intended to promote. The other heads of instruction comprise the elements of mineralogy; technical drawing, with a special view to the manufacture of stuffs, carpets, &c.; and to the construction of machinery, the elements of metallurgy, and the art of mining; a theoretical and practical study of the various processes of textile manufactures, and, in some cases, the mechanism and management of steam-engines.

The education given at these schools is entirely free of cost to the students, and the course of instruction varies from two to four years, but it usually occupies three; in nearly all cases it is accompanied by participation in actual processes of manufacture, more especially of textile manufacture.

The qualifications required for admission are, that the pupil be above the age of fourteen, (in a few instances of twelve,) and that he possesses that rudimentary knowledge which is to be acquired in the upper classes of the primary schools, or in the preparatory schools or evening classes which are attached for the purpose to many of the *Écoles Industrielles*.

Every candidate for admission has to undergo a pass examination before a board composed of the director and professors of the school, and those who fail to pass are allowed to frequent the preparatory school or evening classes, until they have acquired the necessary degree of proficiency. The examinations are both written and oral.

As a general rule only male students are admitted to the schools, but girls are allowed to attend the drawing classes, and the lessons given in the use of the sewing-machine and in photography at the school of Ghent. In Brussels there is a professional school expressly for girls, which is subsidized by the State, and there are certain of the *Ateliers* in Flanders where they receive both primary and technical education.

All students admitted to the schools are required to undergo an examination at the end of each scholastic year, to qualify them for entering upon the course of instruction of the ensuing year. They are also subjected to an examination on leaving the school, in presence of a jury appointed by the managing board, and such as are successful receive a certificate of capacity varying in its terms according to the degree of proficiency shown by the student.

The school buildings are provided and maintained by the communal authorities.

The funds required for the annual support of the schools are derived from three sources: the commune or municipality, the province, and the State.

The management of each school is vested in the hands of a *commission ad-*

*ministrative*, or board of management, of six or nine members, one-third of whom are appointed by the communal council, a third by the permanent committee (*deputation permanente*) of the provincial council, and the remainder by the Minister of the Interior. In some instances the right of nomination is divided equally between the communal council and the government. The director, professors or teachers, and overseers of the schools, are usually appointed by the communal council, subject to the approval of the Ministry of the Interior. In some schools the appointments are made directly by the government on the recommendation of the *commission administrative*. The members of this commission, or a portion of them, vacate their seats every two or three years, but they are re-eligible. Their duties consist in regulating the internal management of the school, subject to the sanction of the communal council; in fixing the hours of instruction, and exercising, in fine, a general superintendence over the discipline and course of studies, and also in ascertaining from time to time, by personal inspection, that the regulations are strictly carried out.

The director and professors meet in council at the end of each scholastic year, and draw up a report upon the condition of the school, addressed to the communal council, and transmitted by the latter to the Minister of the Interior. They have no power to vary in any way the course or hours of instruction prescribed by the administrative commission, nor have they any concern whatever with the religion of the pupils; but they can enforce moral discipline and observance of the regulations, when necessary, by the temporary and even permanent exclusion of those who infringe them. Permanent exclusion of a student must be sanctioned, however, by the administrative commission.

The professors at the *Écoles Industrielles* are in general selected from the Universities, or from the professional divisions of the *Athénées*, or public schools. They are required to have passed an examination and to have received a *diplôme scientifique* or degree, certifying to their scholastic acquirements; others are chosen from amongst students upon whom diplomas have been conferred at the *écoles spéciales* attached to the State Universities, or from engineers in actual employment at industrial establishments.

The classes at most of the schools are held in the evening, when the workshops are closed, and when all those employed in daily labor have leisure to attend; in some localities, however, there are day classes, particularly on Sundays.

The following table exhibits the location, date of establishment, extent of courses of instruction, number of pupils and professors in 1866, and the general aim and character of the several institutions designated by law as Industrial Schools. It includes the Superior School of Commerce at Antwerp, and the Superior School of Mines at Hainault, which belong to the class of higher technical schools.

It will be seen from the table that, including the Museum of Industry, the School of Mines and Industry at Hainault, and the Superior Institute of Commerce, there are fourteen industrial schools in Belgium. The fourteen industrial schools are distributed among the provinces as follows: two in West Flanders, one in East Flanders, five in Hainault, four in Liege, one in Limburg, and one in Namur.

Although originally designed, in most cases, to meet a special exigency in the domestic industry of the country, the scope of all these schools has been gradually enlarged so as to prepare their pupils for a wider field of mechanical activity.



*Location, &c., of Industrial Schools in Belgium.*

Location.	Date of form'n of School.	No. of years in the course.	No. of pupils in 1865-66.	No. of Teachers.†	Aim or Character.
Antwerp. ....	1852	2	65	11	To train merchants and commercial agents.
Bruges. ....	1855	3	253	6	General mechanical, and industrial.
Charleroi. ....	1845	3	520	6	General mechanical training, with department for mining.
Courtrai. ....	1866	3	250	5	Drawing, architecture, and mechanics.
Ghent. ....	1825	4	900	12	Training for chemical pursuits, mechanical arts, textile design, industrial design, photography, sewing-machine school for girls.
Hainault. ....	1837	3	67	9	General mechanical, and industrial, with a mining school.
Huy. ....	1838	*4	165	9	General mechanical, and industrial, with special drawing section.
Hasselt. ....	1864	3	106	....	Improvement trade school.
Seraing. ....	1858	*4	144	7	General mechanical, and industrial, and overseers.
Liege. ....	1825	*4	153	10	General mechanical, and industrial.
Namur. ....	1861	3	80	8	General mechanical, and industrial.
Soignies. ....	1859	2	153	7	For workmen in quarries.
Tournay. ....	1837	3	271	4	General mechanical, and industrial, with workshops.
Two Houdengs.	1864	2	153	7	Overseers and skilled workmen in metals and in mines.
Verviers. ....	1837	*3	312	8	General mechanical, and industrial, with special departments for weaving and drawing.

\* Including one preparatory year.

† Including director and all other teachers.

The number of pupils in those schools, whose creation dates earlier than 1863, was, during the last three scholastic years, 2,293, being about 299 to each. The number of those graduating with diplomas during the same period, and in the same schools, was about 103, averaging about three for each school in each year.

Subjoined is a table of expenses in francs.

*Expenses for 1861 and 1865.*

Nature of Expenses.	Part of the State.	Part of the Provinces.	Part of the Communes.	Total.
1861.				
Museum of industry—expenses of teachers and material.....	f24,186.66	.....	.....	f24,186.66
Industrial schools and Commercial Institute—ordinary expenses.....	78,566.67	f21,000.00	f44,013.33	143,580.00
The same—occasional expenses for material and scientific collections	5,400.00	.....	4,000.00	9,400.00
Public courses, free professional schools, &c.....	4,000.00	.....	5,500.00	9,500.00
Total.....	112,153.33	21,000.00	53,513.33	186,666.66
1865.				
Museum of Industry—expenses of teachers and material.....	23,727.59	.....	.....	23,727.59
Industrial schools—ordinary expenses.....	105,531.95	33,600.00	84,632.17	223,764.12
Subsidies for public courses, &c...	2,700.00	.....	9,300.00	12,000.00
Subsidies for the improvement of the material of the adopted schools.....	5,250.00	.....	4,800.00	10,050.00
Total.....	137,209.54	33,600.00	98,732.17	269,541.71

## INDUSTRIAL SCHOOL AT GHENT.

The Industrial School (*École Industrielle*) at Ghent was founded in 1825 by the Chamber of Commerce, to provide scientific and practical instruction to foremen of shops and factories, and in 1861 was united with the geometrical drawing and weaving school which had been instituted in 1852.

This institution is under the management of a local committee, consisting of nine members, three representing the Chamber of Commerce, three the Communal Council, and three the government.

*Scientific Instruction.*

The course prepares the pupils for chemical and mechanical arts, and for mechanical or textile drawing and design, and extends through four years.

*The first year* of instruction includes mathematics, descriptive geometry, linear and ornamental drawing, and book-keeping.

*The second year*: Mathematics, physics, mechanics, drawing of machinery, and ornamental drawing.

*Third year*: Mechanics, chemistry, spinning, weaving, the motive powers of steam, drawing and plans of machinery, ornamental drawing and composition.

*Fourth year*: Chemical technology, dyeing, bleaching, printing, practical weaving, the analyzation of samples, ornamental drawing in its application to industry, and industrial economy.

A class for steam machinery is attached to the school, for the special purpose of practically instructing engineers and engine-drivers in those branches of physical and mechanical science which are necessary for the proper exercise of their calling.

A class of photography, founded by the way of trial in 1861, and a drawing class for girls, and lessons on the use of sewing-machines, constitute part of the facilities of instruction.

The instruction is given both in the French and Flemish languages, and the average number of students in the year is about 900.

*Practical Instruction.*

The practical instruction in the technology and designing of weaving is given in two sections or classes.

The first of these classes has for its object the making of designs for carpets, paperhangings, cotton prints, foulards, shawls, laces, embroidery, and all kinds of figured and damasked stuffs. The pupil who completes his studies in it is in a position to occupy himself profitably in all the applications of the art of design to those different branches of industry.

The class of technology and weaving comprises instruction in (1) all preliminary operations of weaving, such as winding the bobbins, preparing, mounting and rolling up the warp; (2,) the apparatus employed in these operations, for hand-loom as well as for power-loom weaving; (3,) the preparations of the weft, winding on bobbins and on spools, dressing, and the necessary apparatus for this; (4,) all the parts of the ordinary loom; (5,) the interlacing of the threads; (6,) looms for plain weaving; (7,) the little Jacquard, called the draw loom; (8,) the Jacquard apparatus; (9,) raised weaving; (10,) the arrangement of the cards; (11,) the setting of the patterns, and the apparatus necessary for this operation; (12,) the weaving of damasks, dimity, figured stuff, chinés, velvets, &c.; (13,) the power-loom. Examples are given of calculations for the manufacture, and the course closes by the statement of some finishing processes.



When the professor thinks the pupils sufficiently advanced in their studies, he gives them specimens of stuffs to be analyzed, in order that they may describe the proper processes.

A warping-frame, a common loom for cloth, a loom for damasks, a loom for piqués, a set of patterns and cards, are furnished for the use of the pupils to practise, under the guidance of a foreman and the direction of the professor.

In weaving, the pupils perform all the operations, from the design to its execution in the loom. They analyze and reproduce themselves in woven fabrics all kinds of specimens of stuffs, from the most simple to the most complicated. They acquire thus a complete and minute knowledge of everything relating to the production of textile fabrics; those made by plain weaving, as well as those made by the Jacquard apparatus.

Having completed their studies, the pupils are quite proficient in the different branches of industrial drawing, and are able to execute on commission, and for their own profit, designs for the manufacturers.

*Teachers.*—The teaching body consists of eight professors, including the director, and two assistants.

*Students by their Trades and Studies.*

The following is a statement of the number of students who attended the general course, as well as those who attended the special courses, during the year 1866, inclusive of those who attended them, or part of them, without being actually entered as pupils:

General course of instruction—Flemish, 522; general course of instruction—French, 235; Sunday drawing lessons, deducting those who attended other classes, 93; evening drawing lessons, deducting those who attended other classes, 108; industrial drawing, (day time,) 8; industrial drawing, (evening,) 21; preparatory drawing, 23; weaving and spinning, 46; stokers' and engineers' course, 30; photography, 59; girls' drawing lessons, 14; lessons in the use of the sewing-machine, 118; total, 1,277.

The average number of pupils registered is about 900, more than twice as many being in the Flemish as in the French classes. The trades represented in the former were, in 1866, fitters, 68; iron turners, 28; mechanics, 27; blacksmiths and locksmiths, 84; working engineers, 8; carpenters and cabinet-makers, 66; and 241 miscellaneous. In the French, artisans and clerks, 51; draughtsmen and mechanics, 10; fitters, 2; students, 49; teachers, 5; and 124 miscellaneous.

*Certificates.*—At the close of the course there are examinations held for the purpose of giving certificates of proficiency in various trades, the jury being composed of the professors, one or two members of the administrative committee of manufactures, and of officials belonging to the board of bridges and roads, or to the High School.

*Collections and Library.*—The collections are very large, and receive annual additions of new inventions and improvements. The Industrial Museum has a collection of the series of transformations of material employed in industry. The number of models for drawing is very large. There is a museum of designs composed by the pupils, and of stuffs executed from these designs. There is an increasing library of works upon applied sciences and of periodicals. Connected with it is a reading room, which is much frequented by pupils and artisans. The books in the library are loaned.

The annual cost of this school is about 28,000 francs, (\$5,600,) two-thirds of

which are contributed by the government, and the remainder by the town of Ghent.

The Minister of the Interior, in his report, points out the beneficial influence which this particular school has exercised upon the town of Ghent, and upon its industry in general, and also to the successful career which it has opened to so many of its pupils, who have become foremen or overseers, managers, and heads of industrial establishments. He attributes the introduction of new local industries to the special education which artisan pupils have obtained at the school.

#### TECHNICAL SCHOOL AT VERVIERS.

The professional school at Verviers was created in 1862, by the union of an ordinary industrial school, which had existed since 1837, and a school of weaving and dyeing dating from 1857, both having been originated by the Chamber of Commerce and the commune. It is essentially a communal school, but is aided by the state.

It possesses a corps of eight instructors and (1866) 312 pupils. The course of instruction extends over three years, the first year being preparatory, and is so arranged that at the expiration of the three years the pupil may apply himself to mechanical art, woollen manufactures, or industrial design.

The time occupied in instruction is two or three hours in the morning of week days, Saturdays excepted; and the branches pursued are, in the preparatory year, reading, writing, spelling, elementary arithmetic, weights and measures, linear drawing, the elements of industrial and commercial accounts, and geometrical drawing. The pupils intending to become weavers study, during the second and third years, linear drawing and weaving in all its branches, including the theory, classification, manufacture, composition and analysis of tissues and colors, their theory, contrasts, and combinations. The industrial section, or that of applied sciences, pursues during the same time outline drawing applied to engines and machines; manufactures of wood, metal, and stone; industrial apparatus and factories; shading and coloring; arithmetic and elementary geometry, with special view to planning and surveying; physics, mechanics, and general chemistry with manipulations.

There is a distribution of prizes in October, consisting of mathematical instruments, books, and, for the three best graduating pupils, (one in each course,) a gold medal; and, after passing an examination on foreign industry, a certain amount of travelling money is allowed by the Industrial Society to perfect their knowledge in their own department by observation abroad.

The school is prosperous, although the pupils are often absent at work. There is the necessary supply of apparatus granted by the government.

#### INDUSTRIAL SCHOOL AT TOURNAI.

The Industrial School at Tournai, organized in 1837 as a school for arts and trades, was reorganized in 1860, and consists of an industrial school proper, intended to impart useful information on their trades to tradesmen, and of two workshops, one for weaving, and another for mechanical construction, castings, &c. There is a department for boarders. All these three establishments are independent of each other, but managed by the same committee. To the original establishment, the state, province, and commune contributed in equal proportions 75,000 francs, and several legacies have since been left for its extension.



*Industrial School.*—The Industrial School has a corps of four teachers, and is attended (1866) by ninety-one pupils. The course extends over three years, and includes the following: *First year.*—Arithmetic, geometry, linear drawing. *Second year.*—Elementary mechanics, physics, graphic drawing upon paper. *Third year.*—Applied mechanics, physics, chemistry, industrial drawing, management and conducting of steam-engines. The classes are held daily, from six to eight P. M. in winter, and from six to eight A. M. in summer. Pupils not sufficiently prepared have, during the first year, a morning and evening course of preparation.

The apparatus for scientific instruction is sufficient.

*The Workshops.*—These are open on all working days from half-past seven till twelve, and from half-past one till five. There were, in 1866, seventy-six pupils in both of them.

The workshop for weaving is provided with all the best styles of looms of the English and French market. In this department is a machine showing the improvements in the construction of stocking looms. This last class is open to artisans. A skilled mechanic was brought from Troyes to construct and repair circular looms, and sent to England to study the Paget loom. There are seventeen pupils in the weaving shop.

The workshop for mechanical construction, iron and copper founding and moulding, makes steam-engines of the highest power and most complicated machinery, and machines employed in various agricultural and manufacturing operations. These machines have obtained several honorable notices at various industrial exhibitions. There were, in 1866, fifty-three pupils in this workshop.

Connected with the boarding school is a garden, where six pupils are trained in its cultivation as practical gardeners.

#### INDUSTRIAL SCHOOL AT SOIGNIES.

The Industrial School at Soignies (6,634 inhabitants) was instituted in 1859, originally to form good workmen in the local industry, which is mainly confined to stone-cutting.

The teachers (seven) are connected with the secondary school of the town, where scientific apparatus is at the disposal of this professional school.

The course of instruction embraces a review of the studies of the elementary school, the elements of geometry, physics, and mechanics, with their application to building, drawing from the round, designing, and modelling.

The school has already provided a better class of intelligent and skilled workmen, who design and execute with taste the most complicated work in stone, which before was cut only by professed artists.

#### INDUSTRIAL SCHOOL AT COURTRAI.

The Industrial School at Courtrai (a busy manufacturing town of 22,000 inhabitants, largely engaged in the linen trade) was established in 1866, by the Communal Council, with the assistance of the province and the state.

The instruction, which occupies a three-years' course, with a director and five professors, and a superintendent, is given in two sections: a section of mechanical construction, and a section of the fine arts and architecture.

The industrial or mechanical section comprises the drawing of arabesques, and of the figure, and the outline of machines; arithmetic; geometry in its application to industry; the elements of physics, mechanics, and chemistry, and their application to the special manufactures of the town.

The section of fine arts and architecture comprises the drawing of arabesques, of the figure, and of architecture; drawing from plaster casts, from the antique, and from life; the outline of plans, and the composition of architecture; arithmetic; geometry, and its application to construction; the elements of physics and mechanics, and the application of these sciences to the knowledge of materials and of construction in general.

The two first years of study, comprising linear drawing, arabesque drawing and figure drawing, arithmetic, and geometry, the elements of physics and of mechanics, are common to the two sections.

The third year of study comprises—

*a.* For the industrial section: the drawing of machinery, chemistry, and the application of scientific knowledge to the special manufactures of Courtrai, such as weaving, spinning, bleaching, dressing, dyeing, &c.

*b.* For the section of fine arts and architecture: drawing from plaster casts, from the antique, and from life; perspective, the drawing of plans, the composition of architecture, modelling, the application of geometry, of physics, and of mechanics to the knowledge of materials and of construction in general.

#### INDUSTRIAL SCHOOL AT LIEGE.

The Technical School at Liege was founded in 1825 by two societies, to train overseers of the various manufacturing establishments of the town. In 1832 it was recognized by the commercial authorities as a public institution, and in 1861 was incorporated into the state system.

The course extends through three years, under a director, a professor of geometry and applied mechanics; another of physics and chemistry; a third of mathematics; two of the French language, of history and geography, and two of drawing, besides two in charge of a preparatory section, and a foreman over the special class of working engineers.

The instruction in drawing is given in two classes. In one the pupil is occupied with free-hand drawing, to educate the eye, and the hand; in the other, he practises with the drawing pen, ruler and compass.

The apparatus for illustration was greatly augmented in 1864 by a special subsidy of 13,000 francs, granted by the town, province, and state.

#### INDUSTRIAL SCHOOL OF HUY.

The Industrial School of Huy was established in 1838 by the municipal college for the adult workingmen of the town, and taught by its professors. Satisfied of its utility, the town in 1842, the provincial council in 1845, and the state in 1861, gave it additional aid (3,000 fr. apparatus) and assumed its supervision.

The school consists of five sections, with the following studies:

*Preparatory Section.*—The elements of arithmetic, French, the geography of Belgium, and drawing. Pupils are received in this section who have not acquired sufficient instruction at an elementary period.

*Lower Section.*—The repetition of the elements and higher branches of arithmetic, French, the first elements of geometry and drawing.

*Middle Section.*—The first elements of algebra, geometry, the elements of mechanics, of physics, and chemistry, French, and drawing.

*Upper Section.*—Chemistry, mechanics, physics, French, the history of Belgium, and drawing.

*The special drawing section,* comprises the following subjects: 1. Linear drawing, so organized as to comprise the drawing of machines. 2. Principles of practical geometry, and the orders of architecture. 3. Study of ornament, from copies and from relief. 4. Study of the head from drawing. 5. Elementary perspective. 6. Study of the head from the round.



## IV.—HIGHER TECHNICAL INSTRUCTION.

Belgium possesses several technical institutions of a superior grade, two of which are not to be considered as independent schools, since they consist of separate special schools, and as such form part of the universities at Liege and Ghent. These special schools were founded in 1835, and have been modified at different periods since. Their organization was materially changed in 1856, when they were all included in one common plan, and the instruction in each arranged with reference to a general system. The School of Mining and allied industries at Hainault, and the Superior Institute of Commerce at Antwerp belong to this class, although the latter is described in detail in another connection.

There is now at both universities a two-years' preparatory course for the technical departments, which, at Liege, consists of a special school for mining, a second for manufacturing, and a third for construction of machinery; and at Ghent, of one for civil engineering, and another for manufacturing. The language used in both is the French.

## SCHOOL OF ARTS, MANUFACTURES AND MINING, AT LIEGE.

Under this name, (*École des Arts et Manufactures et des Mines*,) the higher technical instruction at the University of Liege forms a special division. This is the more advantageous, from the fact that the lectures of the university professors—for instance, of mathematics, philosophy, mineralogy, geology, &c.—are also attended by pupils of the technical department. All the higher technical instruction given here aims at educating responsible, scientific men for state service and for private industry. It consists of a preparatory department, which, for the candidates for the School for Mining, lasts two years; for the others only one year, since for the latter the necessary studies of both years are combined into a one-year's course.

In the department of mining, there is a special course of three years' length, and another for manufacturing and the construction of machinery, with a two-years' course. The complete course of study at the school of Liege is, for miners, five; for manufacturers, four; for machinists, three years. The following tables will make clear the somewhat complicated courses of study. The figures represent hours per week. A star denotes one term of six months.

*Preparatory School.*

*First Year's Course.*—Higher algebra; spherical trigonometry; analytical geometry, 3; differential and integral calculus, 4; descriptive geometry, 3; elementary philosophy,  $4\frac{1}{2}$ ; instruction in style and composition, 2\*; drawing, 6.

*Second Year's Course.*—Elementary mechanics, 3\*; analytical mechanics,  $4\frac{1}{2}$ ; chemistry,  $4\frac{1}{2}$ ; experiments in chemistry, 9; elements of geodesy and astronomy,  $4\frac{1}{2}$ .

Those who wish to enter the department for manufacturing or machine construction take a one-year's course, selected from the above studies, of descriptive geometry, elements of philosophy, mechanics, chemistry and drawing.

SCHOOL OF MINING.—(*École Speciale des Mines.*)

	<i>First Year.</i>	<i>Sec. Year.</i>	<i>Third Year.</i>
Industrial physics.....	$4\frac{1}{2}$ *	—	—
Application of mechanics.....	3	—	—
Mineralogy and geology.....	4*	3*	—
Chemical analysis.....	16	—	—

	<i>First Year.</i>	<i>Sec. Year.</i>	<i>Third Year</i>
Analytical experiments.....	—	4½	—
Technical chemistry.....	—	4½	—
Mining .....	—	3	4½
Metallurgy ..	—	4½	4½
Architectural carpentry.....	—	—	4½
Laws of mining.....	—	—	1
National agriculture.....	—	—	1*
Designs of machinery.....	8	8	10

## SCHOOL OF ARTS AND MANUFACTURES.

This is the same as that for mining, and has also a three-years' course, with the same studies.

## SCHOOL OF MECHANICS.

	<i>First Year.</i>	<i>Sec. Year.</i>
Application of mechanics.....	3	3
Construction of machinery.....	4½	4½
Chemistry .....	4½	—
Carpentry .....	—	4½
Plans for machinery.....	13	13
Work in the shops.....	16	16

The manner of giving instruction is the same as in the French schools. In the morning there are generally two lectures by the chief professors. These lectures are general, and the rest of the morning is devoted to a review in detail, in which the theme of the lecture is dilated upon. The whole afternoon is given to study and experiments. Work in the machine shops is considered of special importance. These technical courses are held in a spacious and pleasant building. For the lectures there are three large halls arranged as amphitheatres; for the designing of machinery and architecture there are two extensive halls. There are several class-rooms, each accommodating from 20 to 30 students, and completely furnished with desks, black-boards, &c.

The philosophical collection is important, and contains some remarkable apparatus. There are also large collections illustrating the construction of machinery, mining and architecture.

The machine shops are very interesting. They are situated in a wing which was added expressly for this department to the university by the city of Liege and the province of Brabant, at a cost of 160,000 francs, (\$32,000.) The shops consist of two very large rooms, which are furnished with all necessary machines, tools and apparatus, among which are to be noted a steam-engine, a planing machine, and several screws.

These workshops are leased for a term of nine years to a skilful machinist, who has a salary of \$800 and the use of the premises and machinery. He is bound, in return, to work constantly on large and varied machinery for the public on his own account, and at the same time to instruct students of this branch (construction of machinery) in every step of all practical mechanical work. He is also obliged to furnish steam to the buildings of the technical course.

The whole board of teachers consists of 12, seven of whom are regular professors. All of these, together with many other teachers, (for recitation and drawing,) belong to the *Faculté des Sciences*. The professors have salaries varying from \$800 to \$1,200, besides the lecture fees from the students. They have also, as members of a "faculty," all the rights and duties of professors at a university; appoint their dean, and take part in election of the rector. But as the subjects upon which



they give lectures unite to form one technical preparatory school and three special departments, there is for these technical courses a special council. It has nine members, six of whom are permanent, viz: the Royal Inspector General of Mines, the Director General of Public Instruction, the Administrator of the University, and three inspectors chosen from among the professors; also three members chosen by the King for a term of four years, two of whom are professors and one an engineer of mines. This council superintends the interests of the school and proposes all necessary improvements.

Only those candidates are accepted who have passed a satisfactory examination. The examination is one on the French and Latin languages, (or, in their place, Flemish, Dutch, or English,) history and geography, arithmetic, algebra, geometry, trigonometry, analytical and descriptive geometry, and drawing. The students pay a tuition fee of \$40 in the preparatory school and \$20 in the special schools. The mode of discipline and the examinations are the same as at the *École Centrale des Arts et Manufactures* of Paris. The number of scholars at the technical school in Liege was, in 1862, four hundred; 185 of these were in the preparatory school, 74 in the school for mining, 85 in the school for manufactures, 31 in the machine department, and, finally, transient auditors of various subjects, 25.

SCHOOL OF ENGINEERING, MANUFACTURES AND ARCHITECTURE AT GHENT.

(*Les Écoles annexées à la Faculté des Sciences de Ghent.*)

This school belongs to the Faculty of Sciences at the University of Ghent, namely, a preparatory school and a special school for civil engineering, which is wanting in Liege; a school for manufactures, and a school for those who wish to educate themselves for teachers in mathematics or in the natural sciences. It will be sufficient here to give the course of study in the first, which has two objects: first, to educate engineers for the public service; and, second, to educate architects for private edifices. A star means one term of six months.

*Preparatory School.*

*First Year's Course.*—Differential and integral calculus,  $4\frac{1}{2}$  hours per week; higher algebra,  $4\frac{1}{2}^*$ ; analytical geometry,  $4\frac{1}{2}^*$ ; descriptive geometry,  $4\frac{1}{2}$ ; mathematical philosophy,  $1^*$ ; experimental philosophy,  $4\frac{1}{2}$ ; history and French literature, 2.

*Second Year's Course.*—Analytical mathematics,  $4\frac{1}{2}$  hours per week; stereotomy,  $1\frac{1}{2}^*$ ; chemistry,  $4\frac{1}{2}$ ; civil constructions,  $3^*$ ; elements of geodesy and astronomy,  $3^*$ ; elements of machines,  $3^*$ ; calculation of probabilities and political arithmetic,  $2^*$ .

SCHOOL FOR ENGINEERS.—(*Ecole Speciale du Génie Civil.*)

*Higher Department.*

	<i>First Year.</i>	<i>Second Year.</i>	<i>Third Year.</i>
Science of constructions, (street and hydraulic construction).....	3	3	3
Architecture, building of houses.....	3	$1\frac{1}{2}$	—
Hydraulics.....	$1\frac{1}{2}$	—	—
Machines, science and construction.....	$1\frac{1}{2}$	3	—
Technical chemistry.....	1	—	—
Industrial philosophy.....	—	1	—
Mineralogy and geology.....	1	1	—
Business technology.....	—	—	$1\frac{1}{2}$
Technology of construction of machinery....	—	—	$1\frac{1}{2}$
National agriculture.....	1	—	—
Administrative laws.....	—	—	$1\frac{1}{2}$

In the *lower* department, the students of the two-years' course study some of the branches of the preparatory and engineering school, especially descriptive geometry, elementary philosophy and mechanics, elements of machines and the science of machinery, science of constructions, architecture and technology, whereby students are enabled to pass the examination for "overseer of constructions."

The *Ecole des Arts et Manufactures* has a three-years' course, in which some of the studies of the preparatory and engineering school, especially subjects pertaining to theoretical and practical mechanics, are combined into a three years' course.

The collections are as good as those of the school at Liege. There are no machine shops, but the government has made an arrangement with a machine manufacturer, whereby the latter is paid a sum of \$200 per year for instructing a certain number of students in his machine shops.

All the other relations, as of scholars and teachers, are like those of the schools at Liege, but the number of pupils in both is small.

#### SCHOOL OF MINES AT HAINAULT.

The Special School of Mines at Hainault was founded in 1837. Its aim is to impart instruction directed to the intelligent exercise of all branches of industry, especially of mining. There are eleven teachers connected with it, and about sixty-seven pupils. The course extends over three years, and occupies two hours in the morning, and two in the afternoon. The method of teaching is that adopted at the universities, the branches taught being political economy, chemistry, physics, geometry and algebra, mechanics, metallurgy, geology, the working of mines, assaying, construction, and industrial design.

Conditions of admission are: the candidates must be sixteen, have a knowledge of French, arithmetic—complete, elementary algebra, geometry, and linear drawing.

At the end of the course, certificates of capacity in special branches are given, after stringent examinations before a jury named by the permanent deputation of the provincial council, and presided over by a member of the college.

In 1864, thirteen were graduated; eight in the section for the working of mines; four for the mechanical section; one for the metallurgic. The annual fee for tuition is sixty francs, but it is remitted to indigent pupils. There is a large collection of minerals and a growing one of physics, chemistry, and mechanics. These collections are partly contributed by the professors themselves.



## SCHOOLS OF COMMERCE AND NAVIGATION IN BELGIUM.

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### SUPERIOR SCHOOL OF COMMERCE AT ANTWERP.

The Superior School of Commerce was established at Antwerp, as the principal seaport and commercial metropolis of Belgium, by the city council, with the concurrence of the Minister of the Interior, by a royal decree of October 29, 1852.

Its object is to train competent merchants and commercial agents by supplying an acknowledged deficiency in the system of public instruction—commercial studies not being provided for in the higher classes of the primary system, or in the general or special courses of the secondary or superior schools.

The course of instruction occupies two years, in addition to certain attainments which the candidate must already have made, or must acquire in the preparatory school.

The branches of the preparatory school comprise the French, German, and English languages; history, geography, book-keeping, arithmetic, algebra, geometry, physics, and chemistry.

#### *Subjects Taught and Staff of Teachers.*

The subjects taught in the institution are arranged in two divisions, as follows:

*Theoretical Division.*—1, general history of commerce and industry; 2, commercial and industrial geography; 3, political economy and statistics; 4, an exposition of the general principles of jurisprudence; 5, comparison of commercial and maritime law, and the principles of the laws regulating the relations of commerce; 6, custom laws of Belgium and other important countries; 7, the construction and the fitting out of ships.

*Practical Division.*—1, commercial and banking affairs and book-keeping. A commercial office has been established for the fictitious carrying on of these affairs; 2, the study of natural productions; fabrics commercially considered; 3, correspondence in German and English, as well as in Italian and Spanish.

The staff of teachers consists of a director, eight professors, three office clerks, and two superintending masters.

#### *Course of Study for the First Year.*

1. *Commercial Office, (lower section.)*—The length of the lessons given by the head clerk and two under clerks of the office is four hours daily. The subjects taught are as follows: fictitious negotiations carried on by a commercial house, in all kinds of business, (banking, merchandise, fitting out ships,) on its own account, on commission, for part profits, &c. The application of commercial calculations, and book-keeping, invoices, buying and selling accounts, accounts of expenses, current accounts, accounts for the return of merchandise, &c., operations in exchange, arbitration, public funds, the entering of each transaction in books regularly and practically kept on the principle of double entry, bills of

exchange, contracts of association, bills of invoice, bills of lading, charter parties, engrossing letters, contracts of assurance, accounts for recovering assurances and for special damages, the regulations concerning great damages, &c., usages peculiar to Antwerp and to the principal foreign places, comparison of weights, measures, &c.; correspondence in French, English, and German, on the subject of giving and receiving orders concerning the purchase and sale of merchandise, the consignment of ships and their cargoes; balance-sheet and settling of accounts at the end of the year.

The professors of the English and German languages have also the superintendence of the German and English correspondence.

2. *Commercial Products*.—This course is given on the specimens in the museum annexed to the institution; three hours a week are devoted to it; it comprises the examination and study of the produce of the mineral kingdom, of metallic and non-metallic substances, and of those belonging to the vegetable kingdom.

There is a laboratory, in which the pupils are initiated into the operations of commercial chemistry.

3. *Political Economy and Statistics*.—This class has three hours' lessons every week; every branch connected with the science is taught.

4. *Commercial and Industrial Geography*.—Three hours' lesson every week. Subjects of study, the topography and statistics of the different countries of Europe, Asia, Africa, and America, Australia and Polynesia. These instructions, drawn from the latest consular reports and the most recent communications, touch on the following points: 1, Topographic situation; soil; mineral, vegetable, and animal kingdoms; 2, social and political State institutions, their influence on the prosperity of the country; state of the public finances, national riches, prosperity, decay, their causes; 3, principal productions of each country; the productions which can be procured with profit from them; tables of their exportations; 4, principal productions which each country requires to import; those with which Belgium especially furnishes them; those with which she could furnish them in addition; tables of their importations; 5, a sketch of the legislative economy and customs' duties of each country; obstacles and facilities met by commerce in them; tastes, habits of the population with relation to commerce; 6, detailed information concerning the principal places of commerce, their importance, their manner of conducting mercantile affairs, &c.; origin and determinate causes of the commercial relations between different countries.

5. *Law, (the general principles)*.—This course occupies an hour every week.

6. *German*.—Two hours' lesson a week.

7. *English*.—Two hours' lesson a week.

8. *Spanish*.—Two hours' lesson a week.

9. *Italian*.—Two hours' lesson a week.

#### *Course for the Second Year.*

1. *Commercial Office, (higher section)*.—The lessons last four hours daily.

The subjects forming the object of this course are: The completion of the study of the conditions of purchase and sale, and the general usages in commercial places in different parts of the world; formation of several sections established in different countries, and representing different commercial houses, fitting of ships, commission, assurance, banking, &c.; importations, exportations and transits; book-keeping; accounts; creation, receiving and endorsing bills; operations of the exchange; giving and receiving instructions; the practical application of matters learned theoretically in the other classes; disputed questions; practical operations applying the knowledge acquired in the first course; accounts in each section; the commercial, financial, and industrial relations to be observed with each trading country; correspondence in French, English, German, Spanish, and Italian commercial advices.

Besides daily information from the Exchange at Antwerp, the commercial office receives advices and journals regularly from London, from Liverpool, from New York, from Havana, from Rio Janeiro, from Valparaiso, from Sydney, from India, from China, from Odessa, from Hamburg, from Amsterdam, from Havre, &c. All this information is communicated to the pupils whom it concerns, in the original language.

The professors of foreign languages superintend the letters composed in different languages.



2. *History of the Products of Commerce*.—This course, comprising three hours' lesson in the week, relates to the following matters: continuation of the examination and study of the produce of the vegetable kingdom, of the animal kingdom, and of manufactured fabrics.

3. *General History of Commerce and Industry*.—This course, comprising two hours' lesson a week, is divided into four periods, viz: 1, antiquity; 2, middle ages; 3, renaissance; 4, modern times.

4. *Commercial and Marine Laws Compared; Principles of the Laws of Nations*.—Three hours a week are devoted to this course; it comprises a complete study of the commercial code, including the modifications it has received up to the present time, maritime law, and the law of nations in its relation to commerce.

5. *Custom Regulations*.—Two hours' lesson a week.

6. *Ship-building and Fitting*.—One hour's lesson a week; this class is public and gratuitous.

7. *Commercial and Industrial Geography*.—Three hours' lesson a week. The same subjects are taught as in the first year's course.

8. *Political Economy and Statistics*.—Three hours' lesson a week; same subjects as those comprised in the first year.

9. *German, (higher section)*.—Two hours' lesson a week.

10. *English, (higher section)*.—Two hours' lesson a week.

11. *Italian, (higher section)*.—Two hours' lesson a week.

12. *Spanish, (higher section)*.—Two hours' lesson a week.

The pupils follow only one of the last two courses, at their choice.

Since the commencement of the school year, 1865-'66, instead of four hours' lesson a week, the professors of modern languages give six hours.

The method of teaching is, for the actual classes, analogous to those of the universities. The professor lays down some axioms, and enlarges on them during his lesson, leaving the pupil to make notes of the lecture.

Toward the end of the term, repetitions and catechising are organized, with a view to preparing the pupils for examination.

In the language classes the teaching is more personal. This is also the case in the commercial office, which, properly speaking, is only a simulated counting-house for commercial transactions.

The professor of the history of the products of commerce supplements his course by several experimental lectures beyond the hours fixed for the course of studies.

Repetitions of commercial arithmetic, given by one of the masters, complete the teaching of the commercial office.

All the courses of the institution begin between the 10th and 15th October; they are given in French. The affairs of the commercial office are carried on in the principal modern languages.

Practical lectures on the principal articles of commerce, merchandise, the operation of the Exchange, may be given to the pupils of the second year, either by brokers, merchants, or other practical persons. The pupils visit, in company with the director, the principal commercial and industrial establishments of the city and its environs.

The different lectures are given, morning and evening, before and after the office hours of the institution and the private offices of the merchants of Antwerp, in order to make attendance on them easy to every one.

The materials for teaching comprise the necessary apparatus for chemical experiments, having for their object the testing of the genuineness of goods.

A museum of specimens of natural and manufactured products, and a special library, are annexed to the institution. The government furnishes the exotic productions through the medium of the Belgian consuls; the indigenous productions are obtained either from the government, or from the manufacturers or merchants of the country. These collections will ere long become a permanent exhibition of all which is industrially and commercially interesting to the country.

#### *Pupils.*

Each pupil must enter himself annually on the books of the institution; the entrance fee is 25 francs.

This payment is divided among the professors and masters, in proportion to the lessons given.



The pupil on the list is allowed to be entered for the course; this entry is general or special.

The general entry to all the classes for the first year cannot be obtained by the pupils until they have passed a preparatory examination, qualifying them with the title of scholars of the first year. The fee for this entry is 200 francs.

The general entrance to all the classes of the second year cannot be granted to pupils until they have passed an examination on all the subjects connected with the first year's teaching, entitling them to be called pupils of the second year. The fee is 250 francs.

Only half this sum is paid for each renewing of the general entrance.

Persons who do not desire to pass examinations may attend one or several of the classes on the payment of forty francs; or in case of the renewal of attendance, twenty francs.

The special entrance to the commercial office is 100 francs a year. This entrance is only granted to pupils previously entered with special title to at least three classes of the first or second year of study, not comprising the language classes.

Special entrance is granted at any period of the year. No reduction of fee is made after the commencement of the courses.

No certificate is required for such entrance, except in the commercial office, when the candidate is submitted to an examination before the head clerk, on the elements of book-keeping, French, the rudiments of German and English, and commercial arithmetic.

The pupils entered with a special title cannot obtain a diploma on leaving the institution.

#### *Examinations.*

The examinations are gratuitous. The examination of the pupils of the first year (examinations for admission) takes place once every year, during the first week in October, before a commission appointed by the Minister of the Interior, and presided over by the director.

The subjects for examination are those taught in the professional sections of colleges, and in the preparatory school annexed to the institution; they are—

1. A composition in French, and a translation from French or Flemish into English or German.

2. General geography.

3. The elements of universal history, (ancient history, history of the middle ages, modern history.) The Minister of the Interior fixes every year, in the month of January, what portion of universal history shall form the subject of examination for the October following.

4. Arithmetic and its application to commerce, the elements of algebra, and geometry.

5. The elements of book-keeping.

6. The rudiments of physics and chemistry.

This programme may be modified for foreigners, especially as regards languages.

The pupils who have passed their first examination in some college or academy in the kingdom are exempt from this examination, as are those who have received the certificate of primus in the German gymnasiums, or who can give proof that they have completed their preparatory studies, always supposing that they possess a tolerable knowledge of French and two other languages.

The examination of the pupils of the second year takes place before the body of professors, united in a special commission, and presided over by the director, between the 5th and 10th of August annually. The subjects for examination are named in the programme.

After the second year, juries, nominated by the Minister of the Interior, award to the pupils having the requisite knowledge diplomas of proficiency; and the recipient of this diploma, if a diploma of "great distinction," is eligible for the travelling money granted.

The government commissioner, in reporting on the operation of this school in 1866, states:

The pupils entered, numbered 79 for the school year 1861-2, 60 for that of 1862-3, 77 for that of 1863-4, and 70 for that of 1864-5.



During this period of four years, 32 pupils have gone up for their final examination and to obtain diplomas of proficiency, 23 passed with success, 9 were turned back; among the pupils who succeeded 13 have passed satisfactorily, 6 with distinction, 2 with great distinction, and 2 with the highest distinction.

The number of pupils entered for the courses of the school year, 1865-6, reached 65, distributed as follows:

*First Year.*—Commercial office and correspondence, 57 pupils; history and products of commerce, 37; political economy, 45; commercial geography, 39; law, (rudiments,) 35; German, 46; English, 53; Spanish, 36; Italian, 17.

*Second Year.*—Commercial office and correspondence, 57 pupils; history of commercial products, 14; history of commerce, 17; commercial and maritime law, 14; customs laws, 12; foreign languages, (see 1st year;) ship-building and fitting, 17.

Of the 65 pupils entered, 38 have been entered for the general course, after examination, or after furnishing proofs that they have completed their preparatory studies. The others have followed the special courses as free pupils.

The examinations have yielded the following results: out of 14 pupils who entered themselves for the examination for promotion, 3 withdrew, and 11 were admitted as pupils for the second year. Twenty-five pupils have presented themselves for admission; 12 were admitted with certificates, 11 after examination, one was turned back, and one withdrew.

In the month of August, 1866, 7 pupils underwent their final examination; one was turned back, and 6 obtained the diploma of proficiency, viz: one with distinction and honorable mention, and 5 satisfactorily.

In 1864, travelling money was granted to three pupils, in order that they might complete their commercial studies in India, Mexico, and in the East. Two others obtained grants to enable them to visit Mexico and North America. In 1865, three old pupils received travelling money and the title of Consul-pupil, to enable them to complete their education abroad.

#### SCHOOLS OF NAVIGATION.

There are in Belgium two schools of navigation—at Antwerp and at Ostend. Their reorganization dates from the regulation of October 17, 1833, and February 19, 1849, with slight modifications in 1857. Scholars are admitted during the first weeks of October and March every year. Instruction is made free by stipends, and is given all the year round for at least six hours every day.

The course embraces the following subjects: geometry, stereometry, trigonometry, nautical astronomy, navigation, meteorology, commercial sciences applied to navigation, and English. As often as possible during the year practical lessons are given on board a merchant vessel.

Annual examinations are held for the scholars of both schools by an examining jury, composed of professors of the two schools, which gives certificates to successful students. These examinations are open to persons who have not attended the school, but have in some other way acquired a knowledge of navigation. The certificates of competence entitle the holder to the privilege of "captain," "lieutenant," and "mate," and without which these functions cannot be performed.

Each school has eight whole and sixteen half stipends; the former of 400 francs and the latter of 200 francs.

The inspector, who superintends both schools, is appointed by the government; and each school has a local board of administration.

The total sum annually appropriated is 19,000 francs.

The navigation school at Antwerp has four professors, and numbers 53 pupils; that at Ostend has three professors and 68 pupils.

There is a professor of navigation at Nieuport who gives instruction to a class of professional seamen, who can present themselves for examination to the jury named above.





## AGRICULTURAL INSTITUTIONS AND INSTRUCTION

IN BELGIUM.

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IN Belgium the great leading industry of agriculture has from an early period received the attention of enterprising and public-spirited citizens, as well as the protecting aid of government. So early as 1645, the husbandry of Flanders was so far advanced that the account of it by Sir Richard Weston, published by Hartlib in London in that year, was thought to have added millions to the productive industry of England, by modifying its system of tillage; and for this timely publication, Hartlib received from Cromwell a yearly pension of £100.

The public aid to this great interest is now organized as follows:

### I.—SUPERIOR COUNCIL OF AGRICULTURE.

The Superior Council of Agriculture is composed of two delegates, selected annually by each provincial commission by ballot, and of members appointed by the king. The number of the latter is not to exceed half the number of delegates from provincial commissions. The officers consist of a president and two vice presidents, nominated by the king for each session, and a secretary, who keeps the records.

This council gives advice on subjects submitted by the government, and discusses, from the stand-point of general interest, the wishes expressed by the provincial Commissions of Agriculture, or propositions relating to agriculture made by members of the council in the name of provincial commissions or in their own name. The subjects submitted to the investigation of the council have been, in advance, brought to the knowledge of the provincial commissions and of the members of the council. The deliberations of the council, and the documents relating thereto, are printed at the expense of the government.

The members serve without pay, but their mileage and other expenses, under the action of the council, are paid from the budget of the Interior Department.

### II.—PROVINCIAL COMMISSIONS OF AGRICULTURE.

Each province has a Commission of Agriculture, composed of farmers or agriculturists, equal in number to that of agricultural districts

in the province. A veterinary surgeon of the government is also a member of the commission.

No one can be a member of the provincial commission unless he is also a member of a local agricultural committee or society.

The members of the provincial commissions of agriculture are appointed by the king from a double list of candidates presented by the agricultural committees or societies, as nominated in a general meeting.

The veterinary surgeon is appointed from the candidates proposed by the provincial commission.

No agricultural committee or society of less than 25 members is entitled to representation in the provincial commission. One-third of the provincial commissions is renewed each year; the members can be re-elected. The delegate of the province commission must habitually reside in the district he represents.

The king appoints the president from the members of the commission; also the secretary. The latter has no voice in the deliberations. The governor of the province, if he thinks necessary, can preside at the general meetings of the commission.

### III.—AGRICULTURAL ASSOCIATIONS AND SOCIETIES.

In every agricultural district, which has not a society of agriculture, an association is to be formed; if a district has not a sufficient number of communes for this purpose, it must join a neighboring district.

The objects of the association are :

1. To promote improvements in agriculture, approved by experience.
2. To give to the administration such information as appears useful and in the interest of agriculture.
3. To co-operate with the provincial commission of agriculture.
4. To superintend the execution of regulations in regard to provincial or national expositions of agricultural products.

The association is composed of—

*a.* The members of the commission of agriculture and the veterinary surgeons of the government residing within the territorial limits of the commune.

*b.* An unlimited number of members from the different parts of the agricultural district.

Each proprietor or farmer living in the agricultural district is admitted, if he desires, unless incapacitated by civil law.

The association establishes a common fund, into which an equal sum is paid by each member, fixed by resolution of a general meeting.



This fund, together with the subsidies of the state and the province, is destined to defray—

1. Expenses of administration.
2. Expenses of fairs and expositions.
3. All expenses for the purpose of facilitating agricultural improvements within the district.

Members not paying their contributions within the first quarter of the year are excluded from the association.

The association is administered by a president, vice president, secretary, treasurer, and a counsellor. All officers are elected by ballot for three years, and are re-eligible, one-third going out each year.

In 1864 the different agricultural associations of the state included 14,315 members.

Every year a distribution of prizes takes place within the association. The prizes consist of medals with the likeness of the king, numbered, or in implements of use in the district.

In the general meeting of the second half of every year, the association defines the principles of competition for the next exhibition, the mode in which the prizes will be awarded for agricultural and horticultural products, for the best cattle, or farming instruments, &c. This programme must be approved and is generally approved by the authorities of the association, that all inhabitants may have an opportunity to concur.

The competition is principally for the purpose of encouraging—

1. Persons whose agricultural or horticultural establishments are kept with the greatest care, and managed on the best principles.
2. Those who have introduced essential improvements in one of the branches of agricultural industry.
3. Those who raise the handsomest and best cattle.
4. Those who have manufactured or introduced, or those who use the best instruments for farming or rural economy.
5. The artisans, masters or fellows, who by their profession benefit agricultural industry, whose intelligence, services, and deportment are regularly verified.

Special juries, nominated by the officers of the association, pronounce on the merit of the competitors; these juries must be selected from competent persons outside of the district, and cannot participate in the prizes.

#### IV.—EDUCATIONAL INSTITUTIONS.

By the organic law of July 18, 1860, the state established the following institutions for instruction in agriculture and kindred subjects:

1. An agricultural school.
2. Two practical schools of horticulture.
3. A veterinary school.
4. School of forestry.

#### I.—STATE AGRICULTURAL SCHOOL AT GEMBLoux.

The agricultural school was founded at the expense of the state in Gembloux.

##### COURSE OF INSTRUCTION.

The course of instruction embraces—

##### 1.—*Theoretical Instruction.*

*a. Rural engineering*, comprising elementary algebra, plane geometry, stereometry, surveying, levelling, linear design, the elements of mechanics, the construction of farming instruments, agricultural machines, country roads and buildings, drainage and watering.

*b. Physical and chemical sciences*: natural philosophy, meteorology, inorganic and organic chemistry, as applied to agriculture, chemical analysis, and agricultural technology.

*c. Natural history*: mineralogy, geology, botany and zoology, as applied to agriculture.

*d. Zootechny*, comprising the elements of anatomy and animal physiology, exterior hygiene, production, raising, improvement, and training of domestic animals.

*e. Cultivation*, including general and special agriculture, forest culture, tree and horticulture.

*f. Rural and forest economy*, comprehending the principles of social economy, the system of cultivation, distribution of crops, agricultural stock, theory of vegetables, animals, agricultural arts, woods and forests, as belonging to rural exploration, land and forest administration.

*g. Rural laws*: the elementary principles of civil law; the decrees, regulations, and special laws of interest to the proprietor and farmer.

*h. Agricultural accounts.*

##### 2.—*Practical Course.*

The practical course embrace the application of the preceding.

*a. Rural engineering*: exercises in linear design, surveying, mensuration, gauging of waters, plans, devices, and execution of works of drainage and watering, plans and devices of rural construction.

*b. Physical and chemical sciences*: chemical manipulations, examination and analysis of soil, pasture, and the several products of agricultural industry; visits to brick-works, lime-kilns, factories of drainage-tubs, starch-factories, breweries, distilleries, sugar-factories, &c.

*c. Natural history*: herborization, excursions for geology and mineralogy.

*d. Zootechny*: demonstrations for the course in anatomy and physiology; harnessing, grooming, management of animals for the slaughter-house, of milk-cows, of working oxen, of wool-growing beasts; examination of animals for sale, visiting studs, stables, flocks, market, expositions; sanitary visits, and attendance at veterinary operations, &c.

*e. Cultivation*: use of implements, instruments, vehicles, machines; preparatory labor of the soil, tilth, harrowing, manuring, seed, and artificial multiplication; weeding, second dressing, hilling, watering, cutting of trees; hay-making, harvesting various crops; mowing, thrashing, &c.; visiting special places of cultivation, gardens, forests, nurseries, and agricultural work.

*f. Rural economy*: organization of agricultural work, and reports on explorations under superintendence of the pupils; estimates, plans of farming, visiting of farms, &c.



*h. Agricultural accounts* : keeping of books in reference to special cultivation ; opening, keeping and closing of accounts, balances, inventory, budget, balance-sheet, &c.

For practical instruction, they have a farm, cultivated by the state, an agricultural and industrial establishment, under direction of the Society of Gembloux, special tracts of land for experimental cultivation, and gardens.

The course of instruction embraces four years. A boarding-house is connected with the institution.

### 3.—*Teachers.*

The *personnel* of the institute consists of *one director* and *one sub-director*, five professors, among whom one is charged with keeping the accounts of the establishments, *three monitors*, *one steward*, *one gardener*, *two overseers*, and the persons necessary for the interior service.

The director, appointed by the state, receives a salary of 4,000–5,000 francs.

The sub-director, appointed by the state, receives a salary of 3,500–4,500 francs.

The professors, “ “ “ “ “ 3,000–4,000 “

The steward, “ “ “ “ “ 2,000–2,500 “

The monitors, “ “ “ “ “ 1,500–2,000 “

### 4.—*Supervision.*

A committee of five members, appointed by the state, is entrusted with the chief supervision of the agricultural institute. This committee is renewed every two years ; but the old members may be reappointed. It is their office to advise on the expenditures and accounts ; to control the studies, administration and discipline. They can visit the different classes and localities ; examine the books of the director and the book-keeper ; inspect the material, the collections, and the boarding-house. Each year they report to the Minister of Interior the result of their visitations.

At the close of every scholastic year the committee of supervision, the director, and the teachers meet in council, to deliberate on such improvements in the system of instruction, administration, and interior management as the experience of the year may suggest.

### 5.—*Pupils.*

Pupils cannot be admitted before they are 16 years of age ; outside pupils at 18 years. They must pass a satisfactory examination, from which are exempt those who have obtained an academical degree. At the end of every year public examinations in theory and practice of agriculture take place ; and certificates are given to the pupils who have finished the three-years' course. The annual contribution for boarding pupils is 700 francs ; for outside pupils, 300 francs, paid quarterly in advance.

## II.—STATE PRACTICAL HORTICULTURAL SCHOOL AT VILVORDE.

A practical school of horticulture has been established at Vilvorde, under the auspices of the state.

### COURSE OF INSTRUCTION.

*Botanic* : Anatomical elements of plants and organs of nutrition.

*Floriculture* : cultivation of herbaceous plants.

*Cultivation of kitchen vegetables*, pot herbs.

*Horticulture* : Succinct study of the parts which constitute the ligneous organization, and the necessary knowledge of the functions of these parts ; general principles of multiplication of trees and shrubberies ; special cultivation of pear and apple trees.

*Arithmetic* : fractions and problems.

*French and Flemish languages* : Elementary grammar to syntax ; grammatical and logical analysis ; composing notes on practical work.

*Practical labor* : Digging, clipping.

## III.—STATE VETERINARY SCHOOL AT CUREGHEM.

The veterinary school at Cureghem is under one director and eight professors, with four monitors, an accountant, steward, clerk, and two servants. A physician, also, is attached to the school.

## CONDITION OF ADMISSION.

Previous to admission, pupils are required to pass an examination in the following matters :

1. *French language* : Exercises on grammar, especially syntax ; grammatical and logical analysis ; composition of a given subject, narrative or letter.

2. *Arithmetic* : The four rules applied to number ; vulgar, decimal, and compound fractions ; divisibility of numbers ; periodical decimal fractions ; square and cube root ; proportions ; rule of three, simple and compound ; rule of interest, discount, and partnership ; alligation and mixture ; progressions ; metrical system.

3. *Algebra* : Object—explanation of signs ; reduction of similar terms ; addition and subtraction ; rule or signs of subtraction ; rule of multiplication ; remarks on these rules ; division of monomials and of polynomials ; solution of equations with one and two quantities ; problems.

4. *Geometry*.—(a.) *Plane* : Demonstration of theorems and solution of problems contained in the first three books of Legendre ; inscription of regular polygons in a circle ; expression of the measure of circumference ; area of circle.

(b.) *Geometry of space* : Definition of terms ; measure of prism ; truncated prism ; pyramid ; truncated pyramid ; area of cone, of truncated cone ; solidity of cone and truncated cone ; area of cylinder ; solidity of cylinder ; area of sphere ; area of zone ; solidity of sphere ; solidity of spheric sector ; solidity of spheric segment with two bases ; solidity of regular polyhedron.

5. *Geography* : General, of Belgium ; political divisions ; provinces ; arrondissements ; cantons ; communes ; cities ; population ; celebrated men ; special industry ; commerce ; fortified places ; sea ports ; physical constitution ; basins ; plains ; plateaux ; course of water ; rivers ; animal, vegetable and mineral products ; special products of each province ; travelling by land and water ; geographical nomenclature ; general knowledge of surrounding states ; Europe ; the parts of the world.

6. *History* : Detailed history of Belgium ; universal history ; facts connected with national history ; the period of the Franks ; feudal ; House of Burgundy, of Austria ; Spanish and German branch ; war of Spanish succession ; war of Austrian succession ; Marie Theresa ; Brabantine revolution ; French empire ; kingdom of Netherlands ; Belgium independent.

These examinations take place once per year, and the programme is published.

## COURSE OF INSTRUCTION.

The course of instruction embraces a term of four years, and is divided in four classes, as follows :

A. *First year* : Natural philosophy ; chemistry ; botany ; descriptive anatomy of the horse ; dissections ; principles of horse-shoeing ; herborization.

B. *Second year* : Natural philosophy ; chemistry ; descriptive and comparative anatomy of domestic animals ; general anatomy ; physiology ; dissections ; principles of horse-shoeing ; chemical manipulations.

C. *Third year* : Materia medica and pharmacodynamic ; pharmacology ; pathology and general therapeutics ; pathology and special therapeutics ; pathological anatomy ; zootechnic farriery applied ; anatomy of regions ; operative surgery ; clinic ; practical exercises in zootechnic ; pharmaceutic manipulations.

D. *Fourth year* : Pathology and special therapeutics ; surgical pathology ; obstetrics ; farriery applied ; anatomy of regions ; practical operative medicine ; legal medicine ; sanitary police ; practical exercises in zootechnic ; clinic ; pharmaceutical manipulations.

Every year, at the end of the course, is held a general examination for the purpose of ascertaining what pupils can be admitted to the superior courses.



A boarding-house is connected with the school.

The degree of veterinary surgeon is bestowed upon those pupils who have passed one year in the highest class, and who pass a final examination in a satisfactory manner, with distinction, with great distinction, or with greatest distinction.

#### IV.—FORESTRY SCHOOL AT BOUILLON.

This school was established by royal decree of April 22, 1864, at Bouillon, province of Luxemburg.

##### COURSE OF INSTRUCTION.

A two-years' course embraces the following instructions :

##### *First Year.*

*French Language* : Recapitulation of syntax—principles of style, especially epistolary ; Composition : Narratives, descriptions, letters and reports.

*Mathematics* : Review of *arithmetic*, rule of interest and discount ; *plane geometry*, measure of surfaces ; *elementary algebra* ; *rectilinear trigonometry*, levelling by square and graphometer.

*Natural History* : *Botanic*—elementary organs, cells, fibres, tubes, contents, development, grouping ; Compound Organs : Anatomical structure of the stem of the dicotyledons—medulla, sheath, wood, bark, root, leaf, bud, ramification, flower, cover, stamen, pistil.

*Reproduction* : Fruit, grain, germ.

*Physiology* : Structure of plants ; sources of alimentation ; organic principles ; inorganic principles.

*Immediate Principles* : Neuters, superoxygens, superhydrogens, azotes.

*Nutrition of Vegetables* : Absorption, elaboration, growing of wood, germination.

*Nomenclature* : Linne's system—natural method. Principal families of trees.

*Mineralogy* : Mineral species ; rocks—exterior, crystallographic, and chemical qualities. Principal minerals—quartz, lime, gypsum, clay, felspar.

*Forest economy* : Definition, subdivision, sylvaculture. Preliminaries—fundamental principles. Elements—their action on vegetation. Soil—its composition and qualities. Cutting, dressing, measuring, sale, qualities and defects of wood. Carbonization. Wood for industrial purposes ; how to estimate its contents and value. Design.

##### *Second Year.*

*French Language* : Composition, elocution, style, rhetoric, poetry.

*Mathematics* : Geometry and dimensions ; levelling by compass ; topographical levelling ; elementary principles of construction of roads.

*Natural History* : *Geology*—exterior and interior agent. *Zoology* : anatomy, physiology, classification, mammalia, birds, useful and injurious insects, fresh water fishes.

*Forestry Economy* : Management of forest ; inventory ; special statistics ; system of exploration.

*Legislation and Jurisprudence* : Elementary principles of political and administrative laws ; forest code ; laws in regard to fishing and hunting ; commentaries ; decisions.

*Graphic Work* : Draft by compass ; longitudinal and sectional profiles of roads, ditches, culverts, vessels, machines, plans, &c.





## ACADEMIES OF THE FINE ARTS AND SCHOOLS OF DESIGN.

(Compiled from Official Documents.)

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### I.—HISTORICAL SUMMARY.

To understand thoroughly any institution, it is not sufficient to know its present condition, but inquiries must be made into the causes which gave it birth, the circumstances which aided or obstructed its development, and the modifications to which it was subjected on account of changes in the customs of the time and in the wants which the institution was intended to supply.

In tracing the development of instruction in art in Belgium, we recognize four periods since the first art association or guild was founded at Antwerp, in the 14th century, down to the present time.

PERIOD I.—Although public institutions for promoting the science and art of design, as we now find them organized and administered, are of comparatively recent origin, associations or guilds of artists, who opened their schools under the patronage of St. Luke, existed as early as the 14th century at Venice, Florence, and Paris. At first, membership was confined to persons of the same pursuit, and their exclusive object was to recruit their own ranks. In the 17th century they began to admit more liberally from other professions, and adopted the denomination of Academy, under which name they were established at Rome, Paris, Antwerp, Nuremberg, Berlin, and Dresden. Between the years 1711 and 1781 the movement to bring instruction in graphic and plastic art within reach of the people had extended to Padua, Bologna, Augsburg, Florence, Stuttgart, London, Mantua, Amsterdam, Munich, Cassel, Turin, Weimar, Bordeaux, and Frankfort.

The establishment of a school and association at Antwerp was due to the efforts of the eminent painter, David Teniers, the younger, who began to agitate the matter in 1648, shortly after the foundation of that at Paris; and the letters patent of Philip IV, which gave it the title of Royal Academy, as well as certain privileges, are dated from the month of July, 1663. These privileges consisted in eight franchises, which, carrying with them exemption from taxes, contributions, and other charges, were sold, and became a kind of subsidy from the State.

The first attempt in Brussels was made in 1711 by the association of

artists, but the academy had a sickly existence until 1763, when it was adopted by the municipality. Bruges organized its school in 1720; Ghent, in 1750; Tournai, in 1757; Courtrai, in 1760; Malines, in 1771; Ath, in 1772; Oudenarde, in 1773; Liege, about 1775, and Ypres, in 1779. Generally, these institutions were founded not by artists, but by associations of citizens. In Brussels, the corporation of tapestry-workers, painters, and sculptors, judging that a knowledge of art was indispensable to artisans of their respective professions, established a public school of design, and petitioned the magistrates to allow them the occupancy of a room in the City Hall. In Bruges, also, a Free Academy of Painting and Architecture was erected at the expense of the corporation of painters; and this institution has preserved its independent organization to this day. The only aid they asked from the magistrates was a suitable hall. In Ghent, an artist-painter procured the establishment of a school of design by starting a subscription among the citizens, and soliciting from the public authorities the use of a public hall. The academy at Malines was established in the same way, but the academies in Tournai and Liege originated with the authorities; in the former instance with a view to perfect the manufacture of china.

The movement thus widely manifested in these enterprising cities had its inspiration in the universal demand of European society to escape from the yoke of corporations and guilds, which weighed heavily on the most important industries, and by the establishment of schools to train a larger number of real artists.

The preamble of the ordinance of Marie Theresa, dated March 20, 1773, which responded to the aspirations of the most enlightened men in the province of Brabant, reads as follows: "We have seen with regret that the liberal arts, which give so much honor to the country in which they flourish, have been confounded with the mechanical arts, and that in some cities of this province artists are obliged to become members of guilds composed mainly of workmen and artisans." The decree declares that painting, sculpture, engraving, and architecture are not derogatory to nobility, and that every man may freely practise these arts and dispose of their products in the market. This decree was originally applicable only to the Duchy of Brabant, to which belonged Antwerp, as well as Malines and Limburg; but in 1773 it was extended to all the provinces of the Austrian dominion in the Netherlands.

From this date academies and schools of instruction in art were multiplied; the local authorities interested themselves more and more in them, and the communes in various ways aided them, royalty doing



but little beyond a moral patronage and sanction, which, however, was of some advantage. The character of this latter aid is easily understood by reading the letters patent relating to the Academy of Ghent of September 14, 1771 :

“ Her Majesty, desiring to encourage the re-establishment of an Academy of Design, Painting, and Architecture in the City of Ghent, as well as to promote a taste for the fine arts generally, has, with the advice of her Privy Council and the council of his Highness the Duke Charles Alexander, Duke of Lorraine and Bar, her Lieutenant Governor and Captain General of the Netherlands, declared, and does declare :

“ 1. That she has pleased to take said academy under her royal protection and to give it her good will.

“ 2. That this academy can consequently be styled ‘ Royal Academy of Design, Painting and Architecture.’

“ 3. That this academy shall be regulated by the laws and statutes already decreed by the magistracy of Ghent, and that in this respect, as in all others, it remain subject to the superintendence of the said magistracy.

“ 4. That the president and directors of said academy are permitted to have engraved and make use of a special seal, after a design given in their petition, with this inscription : ‘ *Sigillum acad. art., pict., et architect., Ghent,*’ and below, ‘ *Renovato, anno 1770.*’

“ 5. That they may cause to be struck at the mint of her Majesty in the city of Brussels, at the expense of the academy, the medals which this academy may require for the distribution of prizes.

“ 6. And, finally, her Majesty is pleased to grant to students who distinguished themselves in this academy the same number and kind of prizes she has thought fit to accord to similar academies in the cities of Brussels, Antwerp, and Bruges, namely : for the first prize, a gold medal, with ring ; for the second prize, a similar medal, not gold ; and for the third prize, a medal not gold, and without ring. A copy of the present to be sent to the magistracy of Ghent for their information and direction.”

In their origin, it will be seen, the academies were neither communal nor state institutions, and were as independent of both as they could be at that time ; receiving from the magistracy or the commune only the use of a hall and small subsidies towards annual expenses.

From the time of Marie Theresa, the academies relinquished or were gradually deprived of their exclusive privileges, which they exchanged for certain advantages that the communes secured to them ; but the change was not effected without a struggle and protestations, as in the case of the Academy of Brussels. The pupils, in 1762, applied to the Governor General to obtain redress, as they considered, from the action of the magistracy in infringing the right of free association, to which the school owed its foundation, and which till then had never been

contested. The petitioners represent that at the request of a number of artists, the magistracy of the city had granted a room in the City Hall for the purpose of establishing an academy, the expenses of which were to be borne by the pupils; that the latter not being able to contribute the whole of the expense, the magistracy, in the year 1759, made them a grant of ten pistoles per year, continued to this day, leaving the care of all other matters, including the conduct of the pupils, to the directors elected by the members, who always made choice of an eminent artist; that since the year 1759 the magistracy had attempted to appoint the directors of the academy, without regard to their reputation as painters, sculptors, and architects, and had nominated members of their own body, who know nothing of the art of design, and are not capable of instructing young students. In view of this action of the magistracy, the petitioners unanimously requested to be allowed to retain and continue their ancient director, who was well known as one of the best artists and designers of this city; but instead of acceding to their request, one of the city treasurers had come to the academy, accompanied by a director of their choice, and had ordered the petitioners to acknowledge him as director or to withdraw; whereupon all, with few exceptions, retired, and since then the academy had been inactive. Deprived of the advantages of this academy under these circumstances, the petitioners beg for the special protection with which your Highness has always honored the arts."

The magistracy of Brussels, to whom the petition was referred for their advice, recite the facts, as follows:

"By resolution of September 30, 1711, the magistracy granted the request of the painters, sculptors and others, for a room in the City Hall, to be used for instruction in design; and by another resolution, in 1712, light and fuel were granted. The students contributed towards the expense for models and other necessary things. In 1729, they asked for a grant of 100 florins, which was accorded, and in 1737 they received a present of 50 florins to celebrate their 25th anniversary. In 1737, the academy adopted, by permission, a system of regulations, by which the burgomasters and senior treasurer were made honorary patrons, and the appointment of five directors, citizens of Brussels by birth, provided for, one to be elected by the students on successive vacancies, one by the two patrons, and four by a plurality of votes. Five professors were to be elected at first by the seven regents. In the year 1742, the directors demanded an ordinance of discipline for the students. In 1751, the city granted annually a benefice of 100 florins as remuneration for the man serving as model and for other purposes."

This statement does not justify the action of the magistracy; but the



Privy Council, no doubt, viewing the opposition rather in the light of a students' mutiny than as an invasion of the privileges of the academic society, decided against the petitioners.

This and similar transactions show much indecision in the action of the authorities towards institutions of instruction at this period. The same practice did not prevail in all places. The associations which established these schools were almost always obliged to ask for aid and protection from the communal authorities. The assembling of a great number of young men at one place in the city, generally in the evening, called for special police regulations.

The permanent intervention of the state dates to the year 1771. Prior to this date, recourse was seldom had to the sovereign power till that of the commune had been tried in vain. In May, 1754, the members of the Academy of Ghent, established three or four years before, represented to the Governor General that notwithstanding a contribution of ten "escalins" per year imposed on the pupils, they had not been able to meet their expenses; that they were in debt to the amount of 684 florins, and requested an order on the magistrates to allow them an annual subsidy of twenty pounds. The Privy Council refused the request of the petitioners; but on the application of the academy at Antwerp, a decree, June 13, 1764, of the king, was as follows: "The efficiency of the Academy of Antwerp must be maintained, and consequently the magistracy will continue to pay in the ordinary way the annual benefice of 350 florins, with this condition, that an account be rendered of its expenditure."

Another reason justified the intervention of the state in the establishment of academies, namely: that they were considered as corporations, and that the privileges of the associations were subject to previous authorizations. For instance, on the 7th of November, 1776, amateur artists were authorized to form an academy of design in the city of Tamise, under the supervision of the police and magistrates.

Often the intervention of the government was limited to a simple permission to form an association for purposes of art. It must not be forgotten that liberty of association has but recently sprung up in Belgium.

It is interesting to see how individual and associated action diminished gradually and passed to the communal authorities, which assumed superintendence of the academies on the ground of their payment of subsidies or other benefits. At the time the Brabantine revolution broke out, there were twelve academies in Belgium, viz: at Antwerp, Bruges, Ghent, Tournai, Courtrai, Malines, Ath, Oudenarde, Ypres, Liege, and Mons.

Throughout this period the aid of the authorities was very trifling, the communes doing more for the academies than the government. The latter was contented to decree the title of Royal Academy, and the right of stamping medals. The members bore the greater part of the expenses, managing economically, and each giving according to his means; one his personal attentions, another his instructions, and those who could, money to the common work. In proportion as the government acted, this resource of the association diminished.

PERIOD II.—*The Brabantine Revolution and French Occupation.*—The disturbance accompanying the Brabantine revolution, the invasion of the territory by the French armies, the absorption of the provinces into the republic, the continual wars of the empire, were unfavorable to the development of schools of art. Those which existed before these events were reopened, after a longer or shorter interruption, as soon as peace was established. Four academies were founded during the republic: at Diest, in 1796; at Louvain, Turnhout, and Termonde, in 1800. Two owe their foundation to the empire—the Academy of Alost, in 1805, and that of Lierre in 1807. Then the power of the municipalities was much restrained by an absolute central authority, and nothing was done contrary to the views of the government, represented by the prefect, or without its approval. Six more academies were erected about this time, principally by private donations, but dates and other circumstances cannot now be ascertained.

PERIOD III.—*Government of the Netherlands.*—The principles of centralization, inaugurated by the French, were maintained by the royal government, which established its authority in 1815. The fundamental law gave to the king the organization of public instruction, to which the fine arts, as connected with the literary and scientific culture of the country, were assigned. The royal decree of April 13, 1817, declares: “As far as possible, schools of art shall be established in all the cities of the kingdom, where the population is numerous enough to authorize them. The schools should afford to the young, and to artisans, the benefits of instruction in design. They shall, if possible, be free, the cities to furnish the buildings, and the teachers to be appointed by the magistrates, who shall provide for their supervision and support.”

The government took charge of the institutions, and divided their administration between the central and communal authorities, and in this transaction, at least, it did not take the lion's share. The right of nomination allowed to the commune was limited by the obligation to select masters of design from candidates who possessed certificates of ability—a condition exclusively in the interest of the schools. The cer-



tificates of capacity were issued by a commission of independent and enlightened men from the fourth class of the Royal Institute and the two Royal Academies of Fine Arts (of Amsterdam and Antwerp) created by the same decree.

In the decree of 1817 a classification of the different institutions was first officially announced; those of an inferior grade were called Schools of Design, while the title of Academy was confined to establishments in larger cities where a higher range of instruction was required and could be maintained. The programme for the "Academies of Design," besides elementary drawing, included drawing from embossments and living models, architectural drawing, and geometrical and perspective design. Two institutions were called "Royal Academies of Fine Arts," one of which was in Amsterdam for the northern provinces, and one at Antwerp for the southern provinces. To these two institutions a course in painting, sculpture, and engraving was assigned. Though the decree determines their creation, and regulates to a certain extent their organization, yet it leaves to the local authorities the duties of furnishing most of the means for their support, when a system of state subsidies was at the same time inaugurated. To the "Schools of Design" the silver medals and official testimonials were furnished; to those of Brussels and Bruges an annual contribution of 2,000 florins was made. The two "Royal Academies of Fine Arts" at Antwerp and Amsterdam were more liberally treated, each receiving an annual donation of 4,000 florins, besides a stipend to support the best graduate of each at Rome.

In 1819, (April 23,) M. Falck, Minister of Public Instruction and Industry, issued a circular in reference to application of other institutions for subsidies: "The financial situation of the kingdom has not permitted his Majesty to grant the subsidies requested, and the minister, on the part of the king, directs the schools and academies who have solicited the aid of the government to apply to the local authorities." This shows that the schools in question had not at that time the character of communal establishments. Some of the academies established in the preceding centuries had preserved their independent constitution, and continued to be maintained by voluntary subscriptions and to be governed by their own officers; such are the Academy of Bruges and the Institute of Fine Arts in Malines.

The decree of April 13, 1817, assigns also prizes of 1,200 florins for the laureate pupils of the two Royal Academies to go to Italy, and which the successful competitor enjoys during four years. Article 15, of the same decree, establishes prizes for the best works of art in the annual exposition, which shall take place in one of the largest cities of the kingdom.

Besides the reorganization of existing schools, twelve new academies were erected by the government of the Netherlands: of Tirlemont, 1824; Maestricht, 1824; Menin, 1828; Renaix, 1838, and the schools at Sottegem, 1817; Nivelles, 1818; Saint Nicolas, 1818; Ostend, 1820; Grammont, 1821; Wetteren, 1823; Cruyshanten, 1826; Iseghem, 1828. The School of Design at Lierre, which existed long before, was reorganized in 1817. Two of these institutes (Cruyshanten and Iseghem) have since suspended; the Academy of Maestricht is no longer Belgian.

It is not of recent date that efforts have been made to give to schools of design a more practical direction, and more in accord with the present wants of industry. This problem, which presented itself anew after the first Universal Exposition at London in 1851, had occupied the educators and statesmen of France and Belgium as far back as 1830. The society of which Baron Charles Dupin was president introduced lineal drawing into the Lancastrian schools, and the system of mutual teaching after the methods of Pestalozzi and Francoeur. This movement had not escaped the notice of the government of the Netherlands, and led to modifications in the organization and programme of 1817 by the royal decree of October 10, 1829: "On the report of our Minister of the Interior of September 29 last, No. 108, by which we have been informed that the greater number of 'Schools of Design,' mentioned in articles 1 to 4 of our decree of April 13, 1817, have too exclusive a tendency to the fine arts, by which the useful arts are more or less neglected, and these schools have become of little or no benefit to the working classes," etc. The decree goes on to prescribe the study of geometrical linear design, and lays down a programme more scientific than artistic, inasmuch as it gives great preference to geometrical drafting with instruments.

PERIOD IV.—*Kingdom of Belgium*.—After the revolution of 1830, the state was slow to intervene in the management of the academies, lest it should conflict with the constitution, which ordained liberty of instruction and of association. But the subsidies were continued to the Royal Academies at Antwerp, Brussels, and Bruges. The city of Brussels, in 1835, obtained an annual subsidy of 4,000 frcs. for its new Royal Academy of Design, Sculpture, and Architecture; Bruges and Liege obtained an annual grant of 5,000 frcs. each. The Royal Academy at Antwerp, without ceasing to be a communal institution, had its subsidy increased to 25,000 frcs., and all these institutions accepted the inspection of state officials and the general programme of instruction. Under the fostering care of the government and the com-



munes, the establishments for instruction in design have steadily increased and improved, and all are now on a solid basis. One of the most important steps taken by government was the royal decree of November, 1859, by which a Council of Improvement, consisting of twelve members, was constituted, to whom was assigned the supervision and consideration of all matters of instruction in Schools and Academies of Design and the Fine Arts. Of this body, the Minister of the Interior is president, and in his absence the Director-General of Fine Arts, Literature, and Science. Of all meetings, and of all subjects referred to them by the government, and of the condition of the instruction, a report is made to the Minister annually.

## II.—PRESENT ORGANIZATION AND CONDITION.

1. *Official Classification and Denomination.*—Thirty-one schools adopt the title of Academy; four add the word Royal, namely, those of Antwerp, Brussels, Ghent, and Ypres; while the academies at Brussels and Antwerp are styled “Royal Academies of Fine Arts.” That of Ghent is named “Royal Academy of Design, Sculpture, and Architecture of the City of Ghent.” Seven institutes—those of Malines, Louvain, Bouillon, Alost, Saint Nicolas, Mons, and Liege—are called Academies of Fine Arts. This name is properly applicable only to those of Malines and Louvain, which, besides instruction in plastic art, have a section for music. Of the institutions known as “Schools,” (of which there are now twenty-seven,) some style themselves “Schools of Design;” others, “Schools of Design and Architecture” and “Schools of Design and Modelling,” while still others have taken the names of “Communal Schools of Design,” of “Communal Schools of Arts and Mechanics,” or of “Fine Arts.” There is also the “Institute of Fine Arts” at Malines, and the “Normal School of Arts and Design” at St. Josseten-Noode. Official reports recognize three grades: 1, Schools of Design; 2, Academies of Design; and, 3, Royal Academies of Fine Arts.

2. *Supervision.*—The immediate administration of the academies and schools of design is generally confided to a special committee, which often bears the name of administrative council or commission, and is usually composed of members of the city councils or friends of art selected from the citizens. Sometimes the director or the principal teachers of the school are part of it. Often the mayor of the city is the president; but there is no uniform practice or rule. In some localities the commission is appointed by the Archbishop. Two institutes, the old academy at Bruges and the Institute of Fine Arts of Malines

founded 1830, elect their own council. The association, which maintains a school, nominates their administrators and director.

3. *Directors.*—The directors of the different academies are either permanent or are elected for a certain term, or their position is of a mixed system. The Academy of Brussels elects one director for a three years' term of office. In Ghent, the direction is permanent, but distributed among the three principal teachers. There is a director of design, another of sculpture, and a third of architecture.

4. *Fees of Admission.*—Instruction is generally gratuitous. Out of fifty-nine institutions only nine charge tuition fees. In Herenthals, eight out of fifty pupils paid each six francs per year. At Nivelles, pupils pay one franc per month. At Courtrai, pupils not able to pay are taught gratuitously. In Liege, pupils pay thirty francs per year for the superior course and twenty francs for the others, in proportion to the culture required in the teacher. As the schools are purely local, it rarely happens that, with gratuitous instruction, all pupils which can be accommodated do not come from the commune. Only when there is a vacancy can strangers be admitted.

5. *Revenues.*—All receipts are derived from (*a*) the commune; (*b*), the province; (*c*), the state; (*d*), donations, foundations, legacies; (*e*), voluntary subscriptions; (*f*), contributions of the scholars. During the year 1863 the schools and academies of design of Belgium disposed of the sum of 351,683 francs, derived from the following sources: from the commune, 263,504 francs; the province, 8,500 francs; the state, 71,625 francs; foundations, &c., 247 francs; subscriptions, 4,569 francs; contributions, 3,237 francs. These figures show the change which has taken place in these institutes. While from foundations, subscriptions, and contributions, formerly the most productive sources of income, only the small sum of 8,054 francs are derived, the public funds are now taxed with 343,629 francs.

6. *Expenditures.*—The expenditures of these institutions vary widely; the Academy of Brussels costs annually 62,300 francs; that of Antwerp, 58,500 francs; that of Liege, 43,375 francs; that of Ghent, 28,353 francs; that of Tournai, 12,350 francs; that of Bruges, 12,200 francs. Seven institutions, those of Malines, Ixelles, Louvain, Alost, Termonde, Mons and Hasselt, cost between 5,000 and 10,000 francs; seven others, at Lierre, Nivelles, Lokeren, Saint Nicolas, Soignies, Dinant and Namur, between 3,000 and 5,000 francs; and nineteen schools expend between 1,000 and 3,000 francs; six schools between 500 and 1,000 francs; and seven which cost less than 500 francs.

7. *Material Equipment.*—A building, in order to answer the pur-



poses of a school of design, should be spacious, well ventilated and lighted, not damp, and easily and uniformly heated. In 1864, thirty-nine buildings were reported as satisfactory in these particulars. The furniture for the various class-rooms consists of seats and tables, a few black-boards for graphic demonstrations, and wardrobes to receive and protect the models. The system of instruction prevailing from the foundation of academies, and which employs the first years of study to drawing after engravings, has determined the kind of furniture. The three lower classes have desks, at which the pupils work standing. In classes where the drawing is from objects in relief and from nature, the seats are generally arranged in a semi-circle and like an amphitheatre. The pupils are seated, but have no desks. Each has a map and a board resting on his knees. Often a whole class in linear drawing, when all pupils draw from one model, is disposed similarly. For architectural drawing, large and horizontal tables are deemed absolutely necessary. Models of various kinds and cost are provided, viz: (1,) engravings for instruction in drawing; (2,) models in relief, solids, ornaments, busts, figures, fragments, etc.; (3,) models of architecture.

The selection of copies and models is left with each institution, within the range and with the minimum prescribed by the Council of Improvement for each grade. The models are classified in six divisions, arranged according to the difficulty they present to the pupil. These articles range from the simple mast to the perfect statue; from the fragment of a column to an exact model of the Parthenon and the horse of Phidias. The cost of the necessary outfit for a school of the inferior or lowest degree is 604 francs; the second class, 2,470 francs; of the first degree, 5,487 francs. These articles are procured by the government at cost.

The council, in their annual report for 1864, refer with approbation to the liberality of the English government, through its Department of Art and Science, of furnishing to all schools of art the necessary and desirable models and material aids of instruction at a price below the actual cost, making the outfit of an English school of art cost less by one-half than a Belgian school of the same grade. The English government also provides, in the Kensington Museum and Library of Art, a very valuable and almost exhaustive collection of specimens and models in every department of art, in every country, and in different stages of its development.

8.—*Museum of Models.*—The example, both of England and Wurtemberg, of aiding schools of design in the acquisition of good models and a central museum, is made the subject of a special report by the

council to the Minister of the Interior, to which department the supervision of these schools in Belgium belongs. The example of Wurtemberg is thus referred to: "The collection of models in aid of instruction in design and modelling is very rich, and is, moreover, completed by a library containing the most important and expensive works on decorative art published in different countries. This museum is not only serviceable to the schools of the capital, but the objects which it contains can be sent by mail, free of charge, to the schools in the provinces. A moulder is also authorized to furnish at moderate price a copy of any article ordered. Professor Herdtle has designed and engraved a catalogue of all the pieces in this museum which can be had for use in schools; it has the title, '*Models in plaster executed for teaching the art of free-hand drawing, and of modelling, after models in the collection of the Royal Central Institute of Industry and Commerce in Stuttgart, by order of the Royal Commission on Schools for the perfection of Industry.*' This catalogue contains 212 articles, represented on a scale of one-tenth of actual size, with the price affixed. The first 128 articles are exclusively in the department of ornamentation. All our secondary schools of design and modelling should be provided with a similar collection, which can be obtained through Mr. Togmarelli, moulder, No. 15 Prince Royal street, Stuttgart. We recommend the purchase of a complete collection of models for ornamental design; those of antique human figures can be found better in Paris."

The desire expressed in this report was realized without expense, the government of Wurtemberg having presented a copy of each of the 128 pieces of the collection. Upon recommendation of the Council of Improvement, a copy of all ornamental models included in the list published by the English committee was also procured. Both collections are deposited in the Royal Library until a suitable hall, accessible to the public; shall be provided. The Belgian Council, also, has repeatedly expressed the desire that the government should form a collection of all models, graphic and plastic, which can be used for teaching. In its session of September 25, 1861, the royal commission advised, "that it would be useful to establish in the Museum of Sculpture a section of middle age and renaissance," in which all original models or copies in plaster of the best statues, bas-reliefs, ornaments, tombs, etc., of these periods, should be collected.

For the schools of design four premiums are established for the best specimen of linear drawing, introductory to architectural, artistic and industrial design.

9.—*Subjects and Methods of Instruction.*—A uniform programme of



subjects and methods of instruction in all the schools is not attempted, the government exercising the right of approving the programme of each institution as the condition of its receiving any grant in aid. The following plan of studies was submitted by the Council of Improvement in 1861, and is generally followed :

FIRST DIVISION.—*Linear Drawing*.—In localities where no industrial school exists, the course should include *machine drawing, practical geometry, orders of architecture, ornaments* from flat copies and objects, *heads* from flat copies.

Where no other art school exists, there should be added elementary perspective heads from busts.

SECOND DIVISION.—*Academic Drawing*—Human figure, from flat copies; heads and antique fragments from the round; human figure from nature. Ornamental drawing—Modelling from casts of the antique; modelling from nature. Architectural drawing—First course, mapping and levelling; second course, copy of plans, elevations, and sections; third course, design of house, elementary stereotomy, hygiene.

THIRD DIVISION.—Human figure from nature and the antiques. Painting—Studies and composition; practical exercises and oral directions. Sculpture—Studies and composition; practical exercises and oral comments. Architecture—Composition; drafting; oral directions; specifications; stereotomy and legal requisitions as to buildings; construction and technics. Human anatomy. Perspective—History of art and æsthetics.

The Council desire that the instruction given in the principal academies and schools should satisfy the following demands :

(1.) The programme of examination required for admission to the grand prize competition in painting, sculpture, and engraving—per royal decree of October 10, 1850.

(2.) The programme of examination for the grand prize competition in architecture—per royal decree of April 19, 1852.

(3.) The programme of examination for admission as laureate to the grand prize competition in architecture.

A course of engraving is not given in the plan of studies, it being left as a special and optional study in localities where the public interests and tastes may require it. A class in engraving, in wood, stone, and steel, exists at Antwerp and Liege.

No method of instruction is prescribed, each teacher following his own method, having by him facilities for knowing the methods of others, and profiting by the suggestions of criticism and the results of competitive examinations.

10. *Teachers.*—Teachers are elected by the local administration, and the number and the qualifications of each are left to the same board. The Council of Improvement have repeatedly noticed the absence of all knowledge of method in teaching, both in its historical development and its accepted principles; and complain of the constant reappearance of what is claimed to be improvement in teaching, and which, in reality, were plans long since tried and abandoned. The report of 1867 cites from an official circular of the Prussian government, issued in 1863, respecting drawing in the gymnasiums and polytechnic schools, the following passages: “As to methods of instruction, only general directions can be given. The teacher should familiarize himself with the best methods and suggestions; but as he must finally do the work himself, and must secure the attention and stimulate the faculties of his pupils, he must have the largest liberty of method; and even an inferior method, applied with fidelity, will yield more satisfactory results than a better method in the hands of one not familiar with its details. Every one advances slowly and insecurely under the constraint of a half-mastered method.” But while in Prussia teachers in schools of art are left free as to the choice of methods, the government exacts of all candidates for appointment a stringent examination, which is conducted by a commission composed of professors of the Royal Academies of Art at Berlin, Dusseldorf, and Koenigsberg. Among the regulations of these examinations are the following:

“For admission to an examination, the candidate must furnish, (1,) a brief abstract of his previous life; (2,) certificate of his attendance on a gymnasium or polytechnic school of the first grade, to its third class, or have passed the final examination of a normal school; (3,) certificate of moral character; (4,) certificate of attendance as pupil on some academy of fine arts, or of instruction from an artist of acknowledged excellence.

“The examination of the candidate in Prussia embraces the following particulars with pen and pencil: (*a.*) In free-hand drawing—(1,) head from life or cast, in outline and shaded; (2,) finished drawing in crayon of an object of ornamentation; (3,) a study of trees or landscape. (*b.*) In geometrical drawing—(1,) the principles of geometrical projections, solids, &c.; (2,) perspective; (3,) descriptive geometry; (4,) technics and construction of machines; (5,) surveying and laying out. The three last points are reserved for candidates for polytechnic schools. The oral examination includes, (1,) history of art, ancient, medieval and modern; (2,) general anatomy of the human body; (3,) different methods of teaching drawing, particularly those of P. Schmidt and Dupui, and the material aids of instruction.”

11. *Pupils.*—Pupils are admitted into the academies and schools of design at the age of fifteen. In 31 institutions, a thorough knowledge



of mathematics and the elements of natural science are required; in 17, reading, writing and arithmetic; in 14, only reading and writing. If drawing were obligatory in the public primary schools, the age of admission could be reduced to the age of twelve. The period of attendance varies from two to twelve years, with a daily attendance from one to six hours. To complete the programme of the Royal Academy at Antwerp requires 12 years, while that of six others embraces an average of eight years.

In the Royal Academies of Brussels, Antwerp and Ghent, students from all parts of the world may be found; as at Antwerp, in 1863, there were 119 Germans, 10 Americans, 35 English, 5 Brazilians, 1 Scotchman, 1 Spaniard, 48 French, 505 Hollanders, 6 Italians, 1 Japanese, 1 Portuguese, 10 Russians, 4 Swedes, &c.

12. *Concour; or, Competitive Trials for Prizes.*—There are three kinds of public competitions for prizes open to students in art institutions, viz: (1,) Local—confined to each institution; (2,) General—open to all institutions; (3,) Superior—limited to the best pupils of the highest institutions.

(1.) A local competition for prizes takes place in all the public schools of art, except six of recent origin; in thirty-five every year, and in nineteen every two years. They begin at different periods of the year and extend for varying periods, several for six weeks; in others for thirty sessions, and in none for less than twelve sessions. The judges are composed of the teachers of the institution, with artists and amateurs. In the larger schools, professors of the academies are called in. The prizes are medals, books on art, models, and mathematical instruments. The medals bear the portrait of the sovereign, and are of three kinds: (1,) of silver gilt; (2,) of silver, small; (3,) of silver, large. These medals are awarded in reference to the subjects studied, to the efforts made, and to the merits of each candidate.

(2.) The general competition was instituted to test the relative value of the different systems of instruction in the several academies and schools.

(3.) The superior competition was inaugurated by the government of the Netherlands in 1817. Prior to that year, young artists of great promise had been aided by the sovereign, or by municipal authorities, to go to Rome to continue their studies. The artists of Liege had a special foundation for this purpose. But the royal decree of April 17, 1817, provides: "Beside the medals and subsidies already granted, the state gives to each of the Academies of Fine Arts at Amsterdam and Antwerp two pensions of 1,200 florins each, for pupils who have

attended the superior course for one year at least, and have obtained the first prize, in order to enable them to continue and complete their studies in Italy. The competition shall be opened every two years, and the successful artists shall enjoy the pension during four years; the last semi-annual amount to be paid on his return to the kingdom."

The restriction as to the place of studies has been removed, and the number of competitors has been reduced to six. The successful candidate must give evidence of his possessing the general scientific education to enable him to profit by a residence in Italy, and he is allowed one year to enable him to acquire such knowledge. In the space of 14 years, the successful candidate represented painting 5 times, sculpture 3 times, architecture 3 times, and engraving 3 times.

13. *Statistical Summary.*—The following Table exhibits the present condition of this important department of education in Belgium in 1867 :

Provinces.	Annual Expenses.	CONTRIBUTED BY—					NO. OF—	
		Commune.	Province.	State.	Subscriptions.	Pupils.	Pupils.	Teachers.
	<i>Francs.</i>	<i>Francs.</i>	<i>Frcs.</i>	<i>Francs.</i>	<i>Francs.</i>	<i>Francs.</i>		
Antwerp.....	74,873 00	43,500 00	1,300	29,700 00	575 00	48 00	2,648	34
Brabant.....	94,575 00	69,855 00	3,200	21,400 00	.....	120 00	2,090	48
West Flanders.....	30,211 35	22,100 00	.....	5,000 00	2,860 00	245 00	1,664	45
East Flanders.....	57,958 63	52,343 88	.....	4,250 00	300 00	823 75	2,539	61
Hainaut.....	29,509 84	24,900 00	1,000	2,774 92	834 92	.....	811	22
Liege.....	45,675 00	37,575 00	1,500	5,000 00	.....	1,600 00	514	15
Limburg.....	6,450 00	3,650 00	.....	2,400 00	.....	400 00	114	6
Luxemburg.....	1,500 00	1,000 00	400	100 00	.....	.....	91	2
Namur.....	9,680 00	8,580 00	1,100	1,000 00	.....	.....	136	3
Total.....	350,432 82	263,503 88	8,500	71,624 92	4,569 92	3,236 75	10,607	236

From this Table it appears that in the nine provinces there were in operation sixty institutions, located in as many different towns, for imparting instruction in the principles and practice of drawing, and its associated studies, in reference to its æsthetic as well as its immediately useful results. In these 60 academies and schools of art 236 teachers were employed in instructing 10,607 pupils in the principles of art as applied to drawing, painting, sculpture, architecture, and engraving, with their several applications to the principal industries of the nation.

Out of 13,176 pupils registered as pupils in the Royal Academy of Fine Arts at Antwerp from 1854 to 1863 the following professions were chosen: artist painters, 1,172; artisan or decorative painters, 1,470; sculptors, 1,070; architects and designers, 415; carpenters and join-



ers, 3,177; stone and marble cutters, 664; painters of carriages, &c., 300; goldsmiths and carvers, 293; engravers 143; tapestry designers, 218; ship-builders and sail-makers, 247; cabinet-makers, 116; masons, 321; smith and mechanics, 247; diverse occupations, 247; not known, 2,767.

These special institutions were maintained in 1864 at an expense of 350,432 francs, towards which the communes (cities and villages in which located) contributed 263,503 francs; the nine provinces, 8,500 francs; the state government, 71,625 francs; permanent endowments or funds, 247 francs; citizens by voluntary subscriptions, 4,570 francs; and the pupils, in tuition fees, 3,237 francs.

14. *Government Aid to Art and Science.*—In addition to the pecuniary aid and administration extended to the art institutions already described, established for the purpose of instructing young men in the principles and practice of art, the government of Belgium makes liberal appropriations, having the same objects in view, to public museums, galleries, and annual exhibitions of works of art, and to a comprehensive and liberal system of public instruction in science as applied to the great industries of the nation.

The following items of appropriations in the budget of 1867, with a few explanatory remarks, will show the encouragement given to the fine arts by the Belgian government, amounting in that year to the sum of \$200,000 :\*

Subsidies to young artists to assist them in their studies, 14,000 *f.*

Under this head are included the yearly pensions granted—

1st. To the pupils of the Academy of Antwerp.

2d. To the students in architecture attached to the Royal Commission of Monuments.

3d. To the pupils of the Royal Musical Schools (*Conservatoires*) of Brussels and Liege.

Encouragements to young artists who have already given proofs of merit : Journeys in the country and abroad, to assist them in developing their talent; missions in the interest of the arts; assistance to needy artists, or to the families of deceased artists, 15,000 *f.*

Encouragements to copper-plate and medal engraving : To publications relative to the fine arts, subsidies, subscriptions and purchase of works of historical or archæological interest, &c., 30,000 *f.*

Subsidies to Musical Societies, Music Schools : To towns for the institution of grand festivals of classical music; to societies for the encouragement of the Fine Arts, to local exhibitions, &c., 15,000 *f.*

There are a great number of municipal or private music schools or musical societies in Belgium. The government grants them subsidies varying according

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\* We are indebted to our Minister Resident at Brussels, HON. HENRY S. SANFORD, for this and other official documents relative to the system of public instruction in Belgium.

to the importance of the institution. The sum devoted to this purpose may be fixed at about 15,000 *f.*

Every year exhibitions of works of art are opened in the principal towns in the country. The government assists the societies which organize them by granting them subsidies to assist them in covering the expenses of these exhibitions and in purchasing works of art exhibited.

Orders and purchases of works of living artists, or deceased within ten years; subsidies to public establishments, to assist them in ordering and purchasing works of art, 100,000 *f.*

Encouragement to mural painting, with the co-operation of the towns and establishments interested, 100,000 *f.*

Subsidies to churches, for articles of religious furniture, 10,000 *f.*

Academies and schools of fine arts besides the Academy of Antwerp; council of improvement of the teaching of the arts of design, 100,000 *f.*

There are academies of fine arts and schools of design in the principal towns and localities of the kingdom. These institutions, which are placed under the patronage of the towns and subsidized by them, are each regulated by special rules. Some of the most important receive annual subsidies from the government. For instance, the Royal Academy of Fine Arts of Brussels receives annually a subsidy of 20,000 *f.*, 12,000 *f.* of which are specially reserved to the school of engraving.

The academies of fine arts of Ghent, Bruges, and Liege receive each a yearly grant of 5,000 francs. Moreover, the government grants them a collective subsidy, varying according to the importance of the establishment, to be distributed by the managing board between the most deserving and most needy pupils.

The other academies and schools of design receive annually from the government subsidies to assist them in improving their teaching and purchasing models. Moreover, medals are distributed annually to the victorious competitors of the local contests, (*concours.*)

The council of improvement of the teaching of the arts of design is called upon to deliberate on the ameliorations to be introduced in said teaching. It meets in an ordinary or extraordinary session, if requisite. After each session it addresses a detailed report of its proceedings to the Minister of the Interior.

Grand competitions (*concours*) in musical composition, painting, sculpture, architecture, copper-plate engraving, pensions to the victors, 21,000 *f.*

Expenses connected with these grand competitions, sundries, 6,000 *f.*

A competition in musical composition takes place every two years at Brussels; it is open to any Belgian artist less than thirty years of age; the laureate (victor) receives, during four years, a pension of 3,500 francs to go and improve himself in his art in Germany, France, and Italy. Besides the grand prize, a second prize and an honorable mention may be granted. The second prize consists in a gold medal worth 300 francs; this prize, as well as the honorable mention, may be divided.

A competition takes place every year successively in painting, sculpture, engraving, and architecture. It is open to any Belgian artist less than thirty years of age.

The laureate receives, during four years, a pension of 3,500 francs to travel abroad.

The rules and conditions of these competitions are developed in decrees which have introduced from time to time new principles or essential modifications.



Royal Academy of Antwerp, 63,850 *f*.

The Royal Academy of Antwerp is chiefly intended to teach painting, sculpture, architecture, engraving, carried to the highest degree of art, as well as the sciences most necessary for the cultivation of each of these branches.

It strives, moreover, to propagate the taste for the fine arts, to encourage and protect those who cultivate them, by all the means that its organization affords.

Lastly, in its teaching of drawing applied to industrial arts, it endeavors to form, for certain industries, chiefs and workmen provided with acquirements necessary for excelling in their professions.

Considered as an administrative institution, the Academy of Antwerp has in its operations three distinct departments :

The Academy, or teaching of the Fine Arts.

The Museum of Ancient Paintings.

The Academical Body and Museum of Academicians.

Royal Musical *Conservatoire* of Brussels: Subsidy from the state, intended, with those from the province of Brabant and the city of Brussels, to cover the expenses both for salaries and material, 40,240 *f*.

This *Conservatoire* is instituted to give gratuitously to young persons of both sexes instruction in all the branches of the musical art.

A royal decree of March 19, 1848, instituted, instead of the subsidies which were granted to the pupils of this establishment, and which had reached a figure out of proportion to the resources at the disposal of the administration of the fine arts, six entire yearly pensions (*bourses*) of 250 francs, and ten half pensions of 125 *f*. each.

Royal *Conservatoire* of Music, of Liege: Subsidy from the state, intended, with those from the province and city of Liege, to cover the expenses both for salaries and material, 40,240 *f*.

The object of this institution is the same as that of the *Conservatoire* of Brussels.

A royal decree of January 17, 1867, has instituted, instead of the subsidies annually granted to the pupils, four yearly pensions of 250 francs and eight half pensions of 125 francs.

Royal Museum of Painting and Sculpture, salaries, 12,425 *f*.

Material and purchases, costs of printing and sale of catalogue, 23,400 *f*.

This museum is the property of the state. The administration of this establishment is entrusted to a commission, charged to watch over the preservation and proper placing of the works of art forming the collection of the museum. This commission takes for that purpose all the measures it may judge necessary in the interest of the preservation of these collections. It is, moreover, charged to complete as much as possible the collections of ancient and modern masters. It addresses to that effect to the Minister of the Interior the propositions it may think proper.

The collections of this museum are divided into two quite distinct sections, one devoted to the arts of painting and drawing, and the other to statuary.

Besides the sum allotted in the budget for purchases for the benefit of the collections of this museum, the legislature grants extra credits, when necessary, to purchase the most remarkable works of our great masters. The sums applied to this purpose have risen as high as 100,000 and 250,000 francs.

The Wiertz Museum : Salaries of superintendent and porter ; material, and cost of keeping in order, 3,500 *f.*

This museum is the property of the State.

Royal Museum of Armor and Antiquities : Salaries, 8,700 *f.* .

Do. material and purchases ; cost of printing and sale of catalogue ; cost of publication of an edition illustrated with plates and vignettes of the collections in the museum ; creation of a sigallographical section, 19,000 *f.*

This establishment is the property of the State.

The collections in this museum are divided into two sections ; the first comprises objects of every description relating to archæology, particularly national archæology and ethnology ; the second section comprises fire-arms, modern offensive and defensive weapons.

Cost of surveillance of the Modern Museum established in the Rue Ducale, 3,600 *f.*

Cost of preservation, keeping, firing, furniture, and sundry unforeseen expenses of said museum, 5,000 *f.*

This establishment is the property of the State. The collections of this museum are divided into two sections, viz : one reserved to painting, the other to sculpture.

Monuments to the great men of Belgium : Subsidies to the towns and provinces ; medals to be consecrated to memorable events, 90,000 *f.*

In this round sum of 90,000 *f.*, 10,000 *f.* constitute an ordinary and permanent charge, and 80,000 *f.* an extraordinary and temporary charge, and therefore essentially varying from year to year.

Subsidies to the provinces, towns, and communes, the resources of which are insufficient for the restoration of public buildings, 44,000 *f.*

Subsidies for the restoration and preservation of objects of art and archæology belonging to public bodies, churches, &c.; works for keeping in repair such property of the State as may present an exclusively historical interest, 12,000 *f.*

Royal Commission of Monuments : Salaries, 11,200 *f.*; indemnity for members of the commission, 3,600 *f.*; travelling expenses of members of the commission, of secretary and two draftsmen, 6,000 *f.*; library, furniture, firing, printing and office expenses, purchase of instruments, 2,000 *f.*; account of general sittings, indemnity to reporters and publishing expenses, 700 *f.*

This commission, created by a royal decree of June 7, 1835, is charged to give its advice to the Minister of the Interior on the subject of the restoration and preservation of civil public buildings incumbent on the Home Department.

This advice is given, 1st, on the repairs required by the buildings in the kingdom remarkable for their antiquity, the remembrances they recall, or their importance in an artistic point of view ; 2d, on the plans relative to constructing and repairing churches and edifices destined for worship, and all other public buildings in general.

This commission depends on the Home Department only for as much as concerns public monuments and buildings distinct from those of a religious character.

Three architectural students are attached to the commission, each receiving a yearly pension of 600 francs during four years.

Preparing and publishing the bulletin of the Commissions of Art and Archæology, 6,000 *f.*



Travelling expenses of the three commissioners of the Royal Academy of Belgium attached to the Royal Commission of Arts and Monuments, and of the corresponding members of that commission. 6,000*f.*

National Exhibition of Fine Arts, 1866, *ad memorandum.*

General exhibitions of fine arts are opened every three years for the productions of living Belgian and foreign artists.

The direction of the exhibition is entrusted to a committee of arrangements.

Two juries are appointed, the duty of the first being to decide on the admission and placing of the works of art, and that of the second to propose medals, purchases, and pecuniary rewards.

The Jury of Rewards points out to the government, if it think proper, works of remarkable merit, which it considers worthy of being purchased by the State.

A gold medal is bestowed on such artist as has given proof of eminent talent, who has not already attained this distinction at a previous exhibition. The cost of the medal may not exceed 1,000*f.*, nor be below \$200.

The excess of expenses of the exhibition, including the purchase of works exhibited, engraving, &c., of diplomas, &c., over subscription, is met by the government.

#### *Summary.*

In 1867 Belgium possessed 60 academies and schools of art, in which 1,067 pupils were instructed by 236 teachers, at an expense of 350,432 francs, toward which the communes and provincial authorities contributed the sum of 272,000 francs, from a conviction of the resultant benefits to the industries of the people. Toward this sum the state appropriated 71,625 francs for the encouragement of art, as applied to drawing, painting, sculpture, architecture, and engraving.

In addition to this sum of 350,432 francs, the large sum of 87,241 francs was contributed by the state, communes, and provinces toward the special instruction of 1,857 young and adult workmen assembled in 68 workshops provided for this purpose, in the principles and practices of their several occupations, in all of which drawing formed an important element. To these sums must be added the further expenditure of 279,541 francs on 16 special industrial schools located in all the great centres of mechanical, mining, and commercial industry, taught by 111 professors to over 3,000 pupils. This sum does not include the cost of the higher scientific instruction in the Universities of Liege and Ghent, or of the four schools of agriculture or the three schools of navigation. In all these schools drawing receives a large share of attention. Not satisfied with this provision in special schools, friends of art, with special reference to the advancement of industry, now ask that this study be made obligatory in public schools of every grade—the elementary as well as the superior.

## INSTRUCTION IN DRAWING.

*Proceedings of a Congress held at Brussels, September 21—23, 1868, to examine into the best methods of generalizing artistic instruction.*

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BELGIUM, so early and so faithfully and for many centuries the home and fruitful nurse of the arts, the country of Van Eyck and Rubens, has, especially since the year 1830, added many bright stars to the brilliant galaxy of artists of olden times. And as in manufactures and industry, so likewise in arts and sciences, the people, as well as the government, have nobly emulated the efforts made by other and larger countries; yea, in many respects, outstripped them. A recent proof of this zeal is furnished by the Congress of Artists and Schoolmen, held at Brussels in the month of September, 1868, which is all the more important, as the discussions of this assembly throw much light on a subject of vast and general interest, namely, the popularization and improvement of artistic instruction.

By a royal resolution of March 17, 1868, it was announced that during the course of the year an exhibition would be held at Brussels of the drawings by the pupils of the academics and schools of design; likewise of the methods, models, and instruments used in the graphic and plastic arts; and, finally, that at the same time the directors, professors, and teachers of all these institutions, would meet, and consider the best means of furthering artistic instruction. The assembly accordingly met for the first time in the morning of Tuesday, September 21, in the large hall of the academy. Besides a great number of inspectors and teachers from Belgian academics, and of painters and sculptors, there were present delegates from various foreign countries—France, Germany, Holland, and Denmark. The session was opened by M. VISSCHERS, member of the Board of Mines, and president of the committee of organization, the prominent members of which were, M. KINDT, Inspector General of Industry; M. CANNEEL, Director of the Royal Academy of Design, Sculpture and Architecture at Ghent; M. DE TAEYE, Director of the Royal Academy of Fine Arts at Louvain; E. FETIS, Professor of *Æsthetics* at the Academy at Brussels, Assistant Librarian at the Royal Library, and member of the “Class of Letters;” MOREAU, Professor of Perspective and Geometry at the Academy of Fine Arts at Brussels.

M. VISSCHERS, in his opening speech, clearly defined the aim of the assembly and the questions to be discussed. After briefly adverting to the general advancement of industry, arts, and sciences in Belgium since 1830, he adds:

“Gentlemen, you have all seen the remarkable exposition of drawings by the pupils of our academics and our free schools. A jury composed of competent men has been commissioned to judge of these productions, and to propose to the government the distribution of suitable rewards to be given to the authors of the best works. Our duty, on the other hand, will be to examine the questions contained in our programme, which may be expressed in a few words: *Extension of the instruction in the principles of drawing to all the primary schools; and reorganization of the artistic instruction imparted in the secondary and higher schools.*” The subject before us to-day is inseparably interwoven with the true interests of the mass of the people, the advancement of industry, the useful and the fine arts.



The question is, by what means we can place in the hands of all men, particularly the workingman and mechanic, a new instrument to increase their personal capital—the power of usefulness and enjoyment.”

The programme was divided into *two sections* : the FIRST devoted to “*elementary instruction in drawing and its application to manufactures* ;” the SECOND, to “*higher instruction in the arts of design, and to the general means of encouraging it.*”

#### SECTION I.—ELEMENTARY INSTRUCTION IN DRAWING.

The first day was devoted mainly to the subject of the first section. The assembly naturally could not pass such resolutions as would be binding, but could merely discuss the subject thoroughly, and by approving some new method or system, recommend its general introduction, and clear the ground for future action.

The first two questions of the 1ST SECTION were the following :

1. Since instruction in the principles of drawing in all the primary schools is considered eminently useful and desirable, what ought to be the character and conditions of this instruction ? and,

2. What steps ought the government to take to accelerate and permanently improve the teaching of drawing in the primary schools ?

The conclusions arrived at with regard to these two questions, after an animated discussion, were the following :

1. Instruction in drawing ought certainly to be introduced into all the primary schools, and should chiefly consist in linear drawing ; and,

2. Government should take steps at once to supply, as soon as possible, the great want of drawing-masters, and assure itself of their competency by organizing a good system of inspection, by giving diplomas, &c.

After having given the result of the debate on the first two questions of section 1, it will be interesting to notice briefly some of the suggestions of the most competent speakers on these important questions.

One of the first speakers in this first section was M. BRAUN, *Professor at the Normal School of Nivelles*. He hailed that day with joy, as he now saw some prospect that his long-felt wishes would be fulfilled. With regard to the main question, he remarked :

“The children that frequent our schools should learn drawing just as well as they learn writing ; they will thus acquire that ability of measuring with the eye, that precision of the hand, that clear conception and accurate execution, which, when gained at an early age, are never forgotten. By copying, imitating, and reproducing a given model, they will finally create something new in their turn. The school will thus prepare them for the workshop, where, knowing the theoretical rules of drawing and their practical application, they will apply them to their special branch of industry. The chief gain lies in the increased faculty of observation indispensable to a designer, whether he draws the plan of a house, surveys some tract of land, or reproduces the human figure, or inanimate nature in a landscape. Memory herself lends powerful aid to the rational teaching of drawing, placing before our eyes, faces and views, the recollection of which has long since departed.”

M. DARDENNE, *Professor at the Middle School at Andennes*, spoke next, and in a long speech developed his views of the matter, which may be briefly summed up in the following : He recommended the establishment of special conferences of all teachers of drawing in the country for the purpose of interchanging their ideas ; the organization of expositions at certain stated times, in every town and every province ; that the school and the teacher have part of the rewards in order

to awaken some competition—these rewards to be more or less works of art; to furnish the best teachers of drawing with the necessary funds for enabling them to gather new information and more expanded views by travel; to lay greater weight on drawing at the half-yearly examinations of the normal schools; to establish collections of drawings and models in connection with all the cantonal libraries; finally, to admit no one to the office of drawing-master who has not, in a rigorous examination, given sufficient proof of his capability. The usefulness of all these measures was fully recognized by the assembly, although all acknowledged that it would require time as well as strenuous efforts to carry some of them out.

M. DESCHEPPER, *from the Academy of Lokeren*, pronounced in favor of having the instruction in drawing made obligatory in the primary schools by the legislature, and, because as a general rule the time now spent at school was by far too short, to extend that time to the fourteenth year.

The THIRD QUESTION of the 1ST SECTION comprised the following:

- a. What are the best methods for teaching the principles of drawing?
- b. In how far should the use of the printed copy be extended or limited, before allowing the pupil to draw from models?
- c. Is it not essential to accustom the pupil from the very beginning to draw from sight, *i. e.*, excluding ruler and compasses?
- d. Should not the teacher, whilst the pupil is practising the theory of light and shade, perspective, &c., give short explanations?
- e. What works or treatises could serve as guides in imparting the first instruction in drawing?

The consideration of this question, (especially *a*, which implies the others,) naturally the chief question of the 1st section, gave rise to long and animated discussions, leading to no positive resolutions, but bringing to light the various methods followed by the different teachers, giving an opportunity to compare them and select the best. We shall give a short abstract of the most important speeches, indicating the various methods pursued.

M. PAUL GELIBERT, *painter from France*, made some remarks concerning a new mode of teaching drawing, invented by himself. In order to gain time in instruction, he has invented an instrument, which he calls the *perspectometre*. This instrument is a small ruler, by means of which the pupil finds without hesitation the scientific proofs applied to the art of drawing. Based on a law of nature, the development of the visual organ, it does not allow the pupil merely to copy what he sees. Varied in its length according to the varied length of arms, it gives precise results, and can be under the immediate control of the master. Placed at an angle of 17 degrees it gives faultless perspective points. The "*perspectometre*" is not merely mechanical; its application follows the development of the reasoning powers; it goes step by step from the known to the unknown, leaving the artistic development of the pupil to his own discernment, forming his judgment of proportions and distances, and giving a certain ease to his hand.

M. DE TAEYE, *Director of the Academy of Fine Arts at Louvain*, gave his reasons for having the drawing after an engraved copy completely abolished:

"One copies designs after different principles. I know only one, viz: *linear drawing based on elementary geometry*. It has been proved by all men who have observed infants, that in the beginning they do not see, but that they must be taught to see. The child's eyes must be opened, and he must be taught to discover the things which surround him, and this is effected by no other means than elementary geometry. One places before the child some object and impresses its form on his mind, not by means of his seeing it, but through his reasoning powers.



If we, for instance, take a cube, Reason says to the child, 'this cube has different faces,' and makes him understand these faces according to their plan and elevation. This result is obtained by means of very simple instruments made of wire, and one can thus, as I can testify from my own experience, be understood by a child of five or six years of age. After a child has gained this experience, the teacher will succeed in making him comprehend the difference between the form which he has conceived in his mind and the form as it appeared to his eye. There are consequently two ways of seeing, viz: by the reasoning powers and by the eyes. The child should draw from models by means of cross-lines, and should soon get an idea of elementary perspective. In basing the system of instruction on the above-mentioned fundamental principles, the teacher will not be obliged to speak to every pupil separately, which in a large class will always be injurious, as those with whom the teacher is not engaged at the time find too much opportunity for being idle. It is far otherwise when the teacher can devote himself to all his pupils; at the same time the brain is exercised as well as the hands, and through a constantly intelligible mode of teaching the most brilliant results are obtained."

M. VON MARKE thought that the reason for the little advance that was made in drawing was to be found in the circumstance that many teachers did not keep within the limits of elementary drawing, but only tried to make a fine show at the yearly expositions. They consequently let their pupils draw great heads and ornaments, the greater part of which had been touched up by themselves. As regards the method to be employed, he thought that there was something good in every method, but that it was entirely wrong to expect a method alone to form good draughtsmen; if the teacher had experience and the necessary talents he could produce good results, no matter what method he employed. One ought, therefore, not to follow any method in a servile manner, but there ought to be in every school a series of graduated models, which the teacher could place before the pupil and give his explanations, even if he could not draw much himself. As regards the materials to be employed, he thinks they ought only to be paper and pencil, and not black-board and chalk; there should not be any use made of rulers and compasses. The course of instruction should be arranged in the following manner: At least the first four lessons should be employed in making vertical and horizontal parallel lines; after this the pupils ought to commence drawing the elements of geometry, learning at the same time the name of each figure. During the first year each pupil should, twice a month, be called up to the black-board and draw some figure which the master might ask for. He (the pupil) should at the same time give explanations of the figure, thus showing whether he has comprehended and retained the lessons given; after these geometrical figures, the pupil ought to commence to draw rectilinear designs; then those composed of curved lines, thus advancing gradually to the designing of ornaments. Arrived at this degree of instruction, the pupil will be able to take up drawing after nature with advantage. He will commence by copying solids, and the professor should give the necessary explanations, viz: the elements of perspective, and the principles of light and shade. Next should follow models of very simple ornaments, gradually advancing to the more elaborate.

M. KINDT, *Inspector General of Industry*, thought that black-board and chalk were, after all, preferable in the beginning, because in this manner of drawing the pupil had greater freedom. The point in question was to give the working-man the means of expressing his thoughts by a sketch, and to perfect the teaching of drawing in the primary schools where 99 per cent. of the pupils devoted themselves to agriculture or industrial pursuits.

M. HENDRICKS, for many years *Professor of Drawing and the Arts of Design*,



after being urged by many members of the assembly, consented to give an exposition of his method, as follows :

“I hold the opinion that in order to judge a method, one ought, above everything, to examine the conditions under which it has been studied, and the object which its author has in view. The system which, in the year 1861, I submitted for examination to the legislature, was intended to remedy, as far as could be done, the deplorable state of instruction in drawing in its application to our industry and the different trades which constitute the national labor, by introducing into our primary and middle-class schools a system capable of accommodating itself to the various necessities of the different trades. I must state here that I have investigated everything carefully before I became aware of the evil, and found that it consisted alone in confused ideas on the part of the teachers. In my opinion this evil is not the consequence of want of talent in those who teach ; on the contrary, many of our teachers are very competent, and by far the greater number possess undoubted talent. No ; the fault lies in another direction : in that too frequent and widespread mistake, that the study of the human figure suffices, and ought to precede everything else, how inferior soever the trade may be to which the pupil intends to devote himself. There lies the mistake, and the generally acknowledged decline of our artistic teaching in its application to the various branches of our national labor. I will prove this by mentioning a few simple statistics. Upward of ten thousand pupils attend annually our various academies and schools of design, and the majority of them have practised nothing but copying the human figure from engravings or plaster casts. Now, if this exclusive study was sufficient, ought not our manufactures, as a general rule, to show the highest artistic taste ? We all know that this is far from being the case. Nobody will deny that the study of the human figure is the basis of all purely artistic teaching ; but it may likewise be very justly remarked that several branches of art, such as the painting of landscapes, flowers, views of cities, naval scenes and many other subjects, have been cultivated to their highest degree of perfection, without their authors being able to show a profound knowledge of the study of the human figure. A great number of other less important branches of art may likewise thrive without having this study for its basis, and to the decorator or ornamental sculptor, the three natural kingdoms furnish a large number of other elements which are just as indispensable for him. The foundation of his whole art lies more than anywhere else in the study of the various phenomena presented by the vegetable kingdom, from whose inexhaustible sources he from time immemorial has drawn the ideas for his most beautiful creations, and his happiest applications to useful objects, as well as for the architectural designs which antiquity has bequeathed to us.

“I now conclude, from what I have said before, that if a limited study of the human figure has been sufficient for the manifestation of the various branches of art which I have just enumerated, other still less important studies may even be dispensed with altogether, especially by pupils intending to enter trade, which only borrows from art the application of the elements which geometry furnishes, or those which are found in the most beautiful architectural combinations ; and I conclude from this, that if we wish to give back their old renown to all the branches of our national labor, the only way to do it is to apply to them a system of teaching corresponding to their wants, and to divide the instruction in accordance with the way in which the branches of public instruction are subdivided. This I have tried to do for several years by applying experimentally a method deduced from the preceding considerations. I do not pretend to say that this method is perfect ; on the contrary, I have, in every new edition, added some new improvements gained by experience. I do not claim, either, that my method is the only one to be recommended for introduction into our schools. I am too much in favor of true progress to make such a demand ; but what I demand as the sole reward for my efforts and personal sacrifices is this : that a free trial of my method be made without being trammelled by government interference, and that the same privilege be given to the author of every method. According to my idea, all *constitutive* teaching of drawing ought to be elementary ; should take as its foundation geometry, and make the elements of this science subservient to the analysis of artistic forms in such a manner that they are not only an inanimate instrument, but, on the contrary, a means by which the pupil can himself



control and appreciate his work. Every method, then, must be rational, positive, and not leave room for doubt in the pupil's mind. This is the idea which has served me as a starting point in making out the method which I am about to lay before you. I have arranged it in such a manner that the pupil is at once enabled to appreciate the peculiarities of the most complicated forms, using simpler forms with which he already has been made familiar."

The division of studies is briefly given as follows :

"FIRST DEGREE OF TEACHING.—*These studies consist in the free-hand drawing of forms and figures in general, geometrically represented.* Before letting the pupil reproduce a copy of the smallest object, we exercise his eyes and his hands in using elementary figures, which allow him to understand gradually their relative proportions; their characteristic combination, (*ensemble*;) their particular form; and, finally, all their details. On the thorough practice of these preliminary exercises depend the immediate and complete results in the reproduction of forms and figures.

"The pupil, knowing how to construct (by free-hand drawing) a perfect square, and rectangular figures of all dimensions, will gradually apply the generic geometrical figures which he has been taught; this knowledge practically acquired will enable him to understand immediately the characteristic combination of the object presented to him, to analyze all its outlines, and reproduce them in all their relative dimensions. Twenty lessons have been sufficient for adults to reproduce successively, and in a very complete manner, the most complicated figures, not excepting even the human figure. The pupil making these studies on a large scale, on a picture placed vertically, acquires a firmness of the hand and a correctness of the eyesight which have astonished many an artist, and is consequently prepared to enter upon the practical part of the special branch to which he devotes himself.

"SECOND DEGREE OF TEACHING.—*Solids; their construction and their study.*—As in the first degree of teaching, we also here, before letting the pupil copy from some figure, give him the means of understanding the form and the way in which it is composed. We commence by making him understand the construction of elementary figures. He learns first of all the construction of the cube and its different rectangular divisions, and, next, to place it in all the positions possible. If he has once acquired this foundation, he successively refers to it all the generic forms, the combinations of which he makes in the various positions which the professor prescribes; he proves by this that he can see in the space, and that he possesses a correct knowledge of the principal parts of which any figure is composed. Arrived at this point of his studies, he undertakes the construction of more developed figures, at the same time studying the various elements of ornaments in their second degree. He represents, on an even surface, what a moulder represents by his mould. He sees solid forms, and he will soon be able to express his thoughts in drawing, building, &c., forms which constitute the object of his special study.

"THIRD DEGREE OF TEACHING.—*Drawing after objects or figures placed at some distance.*—It is indispensable here, that at the very outset the pupil should become thoroughly familiar with the rules of perspective; but simple and easy as they are in their application to the *whole* figure, just as difficult and tedious do they become in their regular application to the construction of every single *part* of an object. In recommending the study of the rules of this science, we do not mean the rigorous application of these rules to the elevations on the profiles of the thousand different points of a capital (of a pillar) or other architectural ornaments; we will leave this to those men who study science for its own sake; what we want is this, that the pupil learn to know the construction of the objects which he has to represent, that then he may learn to give to all the details of this object their proper perspective position. The same would also apply to the study of light and shade.

"Any pupil who is in earnest, and has thus been prepared by the elementary and analytical study of the three degrees of our method, will be able in less than a year to copy any object placed before him, and do it successfully. Thus does the *first degree* comprise the study of forms, geometrically represented, and the means of reproducing them in all their just proportions, whilst the *second* and *third* degrees have for their aim the initiation of the pupil in the construction and reproduction

of forms and figures such as they present themselves in space. In order to sum up briefly what I have said, I would offer the following resolutions for the consideration of the government and all persons interested in the cause of artistic instruction :

“The teaching of drawing should be divided into three degrees, corresponding to the three degrees of public instruction.

“The *first* degree, limited to geometrical drawing, should embrace all the professional or artistic applications which are connected with this part of drawing. The elementary study of this first part of instruction in drawing should be made obligatory in all the primary schools, and frequent inspections by artists should be held.

“The *second* degree should comprise the study of drawing from figures in the space and its manifold applications to art and industry. The academies of the second and third order, transformed into special schools for art applied to industry, would devote themselves chiefly to this part of instruction in drawing. Every school should have the free choice of the method of teaching, and the studies which would have a bearing on the manufactures carried on in the vicinity. From time to time provincial and general expositions should be held by these schools, and equitable rewards given to the best.

“The *third* degree, the realm of pure art, which requires as much of innate genius as of science, should be confined to two or three academies of the fine arts, placed in the most populous cities. These academies only should give ‘artistic’ instruction, properly so called.”

• M. HENDRICKS closed by inviting the members of the assembly to accompany him some day to the Exposition, where he would show them the practical working of his system; which invitation was accepted.

M. PIRON, *Director of the Normal School at Carlsbourg*, further developed the system of M. Hendricks, which he has introduced into his school, and adds that he would like to see instruction in drawing introduced in the normal schools likewise, and to make a difference, in the method and extent, between town and country schools.

M. DE TAEYE followed in a speech more or less opposing the system of M. Hendricks. He says :

“The chief point is, to establish positive principles, on which to build up all instruction in drawing; whatever may be the method, there is only one art of drawing. Experience teaches us, that, as a general rule, young people commence the study of drawing at a time when they are still far from a choice of employment for life. Two intellectual currents ought therefore, I think, to be brought to bear on every given number of pupils: one for those with whom imagination predominates; the other, for those positive minds which are more inclined towards mathematical exactitude. In order to show the necessity of this division of studies, let us examine what is understood by drawing, and let us analyze its elements.

“Drawing is a language like writing. Reading, *i. e.*, seeing written signs, creates ideas and sentiments. The same result should be produced by drawing, which originally formed part of writing, and is inseparably connected with it in the Egyptian hieroglyphics. Writing finds its expression in certain conventional figures; drawing, by imitating natural forms; drawing is therefore the representation of the real or apparent forms of things, by means of lines traced on an even surface.

“He who knows how to draw possesses likewise in a particular degree the faculty to express every conception of the mind, and thus to make his thoughts, his sentiments, intelligible to all. From this we conclude that all instruction in drawing ought to have for its aim the imitation of the real or apparent forms of objects. What, then, is required to reach this end? Above everything, an exact



knowledge, a clear geometrical conception of the form which one wishes to represent; for what is firmly and thoroughly conceived by the mind is easily executed by the hand. The true form of every object keeps within the limits of geometry; in fact, when we analyze the various objects which nature presents, we discover that all their forms belong to geometry. Geometry, therefore, is the fundamental principle of drawing—the touchstone of every good method; and where this fundamental element is wanting, the teaching will be vacillating and based entirely on imagination. We may here, for safety, establish this principle: the elementary study of every kind of drawing must necessarily be based on geometrical forms, only we shall see that in putting it into practice it is indispensable to pursue two different ways. By geometrical drawing, one arrives at an exact, precise and mathematical representation of the object, taking note of its length, breadth, etc. Thus the mind gets a complete knowledge of its real form, and is enabled to make the most detailed analysis; whilst by drawing from sight one only takes note of the apparent form of the object, according to the point of view from which one considers it, without being able to arrive at an analysis of its real form. The *first* way of drawing obtains its results by means of instruments, such as ruler and compasses, whilst the *second* relies substantially on the exercise of the eye and the practice of the hand. I believe, therefore, that a combination of these two methods is an absolute necessity in order to constitute a complete and rational system of teaching which satisfies the demands of imagination and of reason.” In confirmation of these ideas, the speaker quoted several authors and artists’ words. He then continued: “It is therefore clear that geometrical drawing should form the beginning with every pupil, without distinction, and only after having fully mastered this branch of study should he be allowed to proceed to the study of drawing from plaster casts or nature. The advantage of following this system is incontestable; it leads the pupil gradually by oral and graphic demonstrations from simple to composite forms, developing simultaneously his intelligence and the practice of his hand. The result of this rational mode of teaching is, that the pupil quickly acquires that accuracy of the eyesight and that faculty of judging of proportions which alone make a correct draughtsman. Another great advantage is this: that later, when the pupil is to study the scientific demonstration of descriptive geometry, he will find this very easy, for he knows already the name, the form, and definitions of figures, and more than that, he knows how to draw them; even the solids, that part of geometry frequently found so difficult, do not puzzle him, for he has already drawn them from nature. Another advantage is this: that the pupil is freed from drawing after an engraved copy, which now-a-days very generally has been acknowledged is one of the greatest obstacles in the way of learning to draw, for not only does he not learn to ‘see’ things as they are, but the poor copies which one generally finds in our schools only tend to depress the taste of our pupils, who thus lose their precious time in imitating these copies with their cross-lines of shade or their dotted lines; I may well say that the great majority of pupils, after having lost five or six years in drawing noses, mouths, and at last heads, finally give up the study of drawing from mere disgust.” The speaker believed that it would be utterly impossible, as M. Hendricks asserted, to teach drawing of ornaments and the human figure in 20 lessons.

M. LOUVRIER DE LAJOLAIS thought that as art was “*one*,” so the teaching of art ought likewise only to be “*one*;” that the teaching should rest on these funda-

mental points : the choice of a method appropriate to the age of the pupils ; the time they can devote to this study, and the degree of education which ought to be required from the teachers. The method should consist, naturally, in the study of the practical means of producing on an even surface the image of a solid ; sufficient time should be devoted to the study of drawing ; and the teachers ought to be thoroughly versed in the principles of free-hand drawing and mathematics, and should also have gone through a course of simple æsthetics.

Several others spoke very much to the same purpose, and the discussion on this point was closed.

The FOURTH QUESTION of the 1ST SECTION comprised the following :

*a.* In order to favor the study of drawing, and to answer the wants of modern industry, industrial schools and academies of design have been established. What, therefore, is, from the industrial stand-point, the species of drawing that should be taught there ?

*b.* Should there not be, on a smaller or larger scale, according to circumstances, museums of works of art to serve as models near all such schools ?

*c.* What European institutions set, in this respect, the best example ?

From the somewhat rambling debates on this question, leading to no positive results, we select some of the most important suggestions.

M. PIRON, *Director of the Normal School at Carlsbourg*, drew attention to the great difference existing between the schools in cities and in the country. He said : "The cities have all the resources, while the country has none ; and if our programme speaks of the introduction of teaching of drawing in the primary schools, this means the country as well as the city. What now are the elements in the country to assist the teacher in imparting his instruction in drawing ? There are none. One would seek in vain in all our country schools for a single model. Everything is wanting there. If, therefore, museums are to be founded in our cities, they are an absolute necessity in the country ; of course not on that large scale, but even the smallest school in the country should be provided with a collection of drawing copies, and, perhaps, a few models." M. Piron strongly recommended annual or semi-annual expositions of the drawings produced in all the schools to give a new impetus to the cause, and produce a spirit of emulation among the teachers.

M. KINDT, *Inspector General of Industry*, made a speech, in which, after having dwelt on the general importance of industrial schools, he remarked : "The kind of drawing-instruction imparted in the industrial schools can very well exist by the side of the academies. A professor may be able to teach drawing, but he cannot give to his pupils artistic taste. One must have seen a great many objects of art to acquire a correct artistic taste ; taste is the recollection of the beautiful. Do not believe that the professors in our smaller towns are able to teach their pupils in such a manner as to acquire taste. One way of greatly aiding the professors in imparting instruction would be to give to objects which are continually before the eyes of all, such as a pump, lamp-post, balcony, etc., an artistic form, and thus to cultivate the artistic taste of the working classes. Brussels, and some of our larger cities, have a great many such public objects of art ; but more might be done in this direction in many of our smaller towns, thus aiding the professors of drawing in imparting instruction."

M. C. BULS, *Secretary of the 1st Section*, spoke against the opinion expressed by some of the former speakers, especially M. Louvrier de Lajolais' assertion, that art was "one." He says : "No ; art is not 'one ;' but every nation has its own



idea of the beautiful, which idea finds its expression in the different arts—different because they are based not only on different, but thoroughly antagonistic principles; as, for instance, Greek and Gothic art. I understand why one of the preceding speakers maintains that there is no other way to real art than through the study of Greek and Roman art. It is because he belongs to a nation which has much affinity with the civilization of Greece and Rome. But we, who belong to the Germanic race, ought certainly not to be obliged to pass through the '*furculæ caudinæ*' of Greek and Roman art. Our ancestors, who have raised the glorious cathedrals and other public buildings, of which we are justly proud, were they inspired by the Greeks and Romans? No. Maintaining the *unity* of art kills all *national* art. Art is the most elevated expression of a nation's life, and the arts of the different nations differ as much as their customs, religion and civilization. The nation, then, gives its character to art. Academies will never create any great artistic development. This is only produced when all the conditions required for producing it centre in one period. It is not correct to say that art alone has an influence on industry, for industry, in its turn, exercises a very marked influence on art. The architect cannot merely trust himself to the aspirations of his imagination, but must have regard to the requirements of construction. The architecture of the eighteenth century, with its broken pediments, its curved architraves, its twisted columns, mistaking the essential conditions of all rational construction, has shown what art comes to when it leaves its rational basis. It is not true to say that great art is sufficient to give to an architect the knowledge which we wish to give to the pupils of the industrial schools. If such were the case, we would not see sculptors obliged having recourse to the aid of an ornament-maker when they wish to crown one of their statues with flowers. I maintain, in fact, that the majority of painters are not able to design the frames of their paintings. I have seen with my own eyes in the workshop of an ornament-maker the formless sketches which architects, and architects of renown, have furnished for consoles, mouldings, ornaments of edifices, for which they had drawn the plans, which have thrown much light on their talent for drawing.

“It would not be difficult to quote the names of a considerable number of workmen, who, coming from the workshops of jewellers, blacksmiths, and potters, have risen to the rank of sculptors and painters, such as Palissy, Quentin Matsys, Ghirlandajo Francia, &c. In every age there is a ruling tendency in art, and the painters, the sculptors, the musicians, poets, &c., express in their works the ideal at which the period aims. But below these, I might say along-side of them, there is a host of satellites, who, revolving in the same orbit, form small groups, with an independent life of their own. They are as much active centres of invention, and it is not in accordance with truth to say that they shine merely with a borrowed light. Any one who is acquainted with workshops knows that there is no lack of workmen endowed with a certain artistic education; men who every day invent new combinations, reflecting the general character of art. In short, I claim the introduction into the academies of design of a course of applied archeology and æsthetics. If any one should doubt the possibility of rendering these sciences popular, we can produce conclusive evidence of this having been done in a satisfactory manner. Such a course would also give to the people some general notions of history, initiate them into the character of the great civilizations which have preceded ours, and cultivate their minds in many ways. How often has the varied culture of the artists of the renaissance been spoken of.

with admiration! men who were at one and the same time painters, sculptors, architects, jewellers, engineers, musicians, and poets. Has the elegance of their works ever been equalled? Such a course of instruction as I mentioned above would add considerable interest to the technical instruction by teaching the pupil the reason, origin, the signification, and the character of the forms which he employs; under his very eyes they would become animated; for the professor who is to give this instruction should abandon the dry descriptive and analytical method of archeology and French æsthetics, and boldly cast himself into the broad domain of German æsthetics, which has been rendered so fertile by the admirable works of Visschers, Boticher, Schonaase, Lübke, Semper, Springer, and Lotze.

“There the artist does not place himself before a work of art merely to analyze all its details, but he sees in it a living organism, all the parts of which are developed as beautifully and regularly as the leaves and flowers of a plant; it is no longer a production produced by accident or the individual fancy, but the natural unfolding of plastic forms, the types of which take root in the very depth of our social being. Such a method gives to the teaching of archeology and æsthetics a life, an interest, which make it so attractive that I do not think I am exaggerating when I say that it will awake among the pupils a true enthusiasm for art. I even go further, and I say that such a course of instruction is imperatively demanded by the cosmopolitan character of our time, our frequent journeys, the interest which the recent archeological researches awaken, by enabling us to comprehend the most different styles of beauty. All this exposes us to the danger of mixing our styles, and of offending good taste by the alliance of forms which are entirely opposed to each other, or by employing them in a manner different from that for which they were originally intended. It is therefore necessary that the pupil thoroughly masters the essential character of each style, in order that he may always employ the right elements in the right place. This course should be limited to history of art among the European nations, and should consequently comprise the history of the Greek, Roman, Romanic, Gothic, and renaissance styles; also the history of the styles of the 17th, 18th, and even the 19th centuries, in so far as their characteristics can be determined. It would be well to add the Moorish (moresque) style, which would furnish numerous illustrations for the theory of colors, the laws of which have been so accurately laid down by Mr. Brucke in his lessons at the Imperial Museum for Art and Industry at Vienna. It is easy to shorten or to extend this course in proportion to the pupil's degree of intelligence and culture. According to his advancement, he might learn from six to twelve lessons in one hour. After the general course has been gone through, one could, in some lessons, give the history of some special industrial art, such as sculpture, the locksmith's trade, book-binding, the goldsmith's trade, &c., for such pupils as have already chosen a trade. It will scarcely be necessary to say that the professor ought continually to place before the eyes of the pupil the objects, or at least good copies of the objects, of which he speaks. These objects he should find in the museums, which ought to be attached to every school of design, and the necessity of having such a museum is so self-evident that it does not need any argument. The institution at South Kensington has shown the way, which every school of this kind should follow, sooner or later. The professor would do well to make excursions with his pupils to monuments and collections of art in the neighborhood; to draw his illustrations, if possible, from



the history of the national art, and endeavor to inspire his pupils to connect their own work with the traditions of their own country's art. What we finally demand, is this :

“1. Every school of design should have a course of history of ornaments as a supplement to the technical teaching of the arts of drawing.

“2. The professor should, in such a course, endeavor to connect the productions of art with the different manifestations of the nation's life which has produced them, so as to give the pupil some general idea on the history of civilization, and this by taking account of the German æsthetics.

“3. Every school of design should have a museum comprising a methodical exposition of specimens of the various styles of ornamentics.

“Besides the influence which such an instruction could not fail to exercise on the production of the pupils, it would also, in my opinion, have the advantage of increasing in the schools of design a tendency, which they follow wherever industrial art is foremost in the minds of people, namely, the tendency to change gradually to industrial schools, to school-workshops ; here lies the road to a radical reform of primary instruction, which has already been followed by some, and with a happy result, for we see in it the means of attaining a more general diffusion of instruction by the universal attendance at the school during all the time required for the acquisition of a good and solid education.”

M. BRAUN, after some discussion on the question how far museums or collections were practicable in all the schools, made the following practical propositions, which were received with applause :

1. For the primary and normal schools, a well-defined, well-limited, well-co-ordinated method of drawing is required, in accordance with the nature and the aim of the establishment, and with all the time which can be devoted to the study of this branch.

2. In order to obtain the best results in the normal schools, a larger number of drawing lessons is required, and more attention bestowed on it at the half-yearly and final examinations.

M. CANNEEL mentioned the example which England has set with regard to museums. Duplicates of all the objects have been procured for the central museum at London, and thus a small museum has been formed which answered all reasonable demands. During the last nine years this museum has made forty journeys ; 75,000 persons have seen it, and 35,000 catalogues have been sold ; and this catalogue gives excellent instruction on all the various objects contained in the museum— is in fact a brief course of archeology. This museum is placed in two railroad cars constructed expressly for its use, and only one man accompanies it.

M. DE TAEYE could not refrain from making some remarks with regard to an idea mentioned by M. BULS in his speech, viz, “that it was not necessary to extend the study of archeology into antiquity.” Although M. BULS denied having said this, M. DE TAEYE said : “I ask, how can it be possible to understand the middle ages, if one does not know the landmarks which have preceded it? I maintain that it is not possible to understand the middle ages if one does not know the Greek and Roman art. To give one example : there is between the sculptures, the figures of Rheims and the Greek art, such an intimate, astonishing connection, that you could not appreciate the beauties of the sculpture of the middle ages in France but by placing before them the most beautiful productions of Greek art. Phidias alone is worthy to be placed by the side of the beauties of the cathedral

at Rheims. The traditions of Greek art had been preserved during the downfall of Greece. Through the crusades they have been carried all over Europe, and are reflected in the beautiful sculptures of the middle ages. Every artist who has attentively studied the works of these two periods will be convinced of the truth of what I have said." These remarks of M. DE TAEYE were received with applause, and the president announced the discussion on the fourth question as closed.

SECTION II.—HIGHER INSTRUCTION IN THE ARTS OF DESIGN.

*1st Question.*—Up to the time of the foundation of academies, the graphic and plastic arts were only taught in the workshops of artists. Public schools have to-day replaced the ancient mode of teaching. The question is to examine the merits and demerits of the two modes of instruction.

Passing by the discussions on various less important questions, we proceed at once to give the chief speech on this subject, made by M. DE TAEYE. He said :

"A speaker who preceded me (M. Cluysenaar) has asserted that the academies are badly organized, and that everything which is there should be entirely re-made. Gentlemen, these accusations go much further. I even go so far as to say that it is quite in accordance with the character of our times to consider the word 'academical' as synonymous with mediocre and bad. I will now endeavor to show that this way of reasoning is entirely, radically false. It is said that academies were first founded in those times when art declined, and that, therefore, their organization must be bad. I maintain, gentlemen, that the academy was not created at the time of the decadence of art; on the contrary, it is as old as the revival of modern art. The whole period of this revival, (renaissance,) from its commencement in Italy, in the 15th century, till the time of its greatest splendor, under Raphael and Michael Angelo, was pervaded by academical elements and animated by a purely academical spirit. The manner in which Squarcione, the founder of the school of Padua, exercised his wide-spread and beneficial influence, is entirely academical. From a union of the works of art of antiquity, and their methodical study, he formed the basis of his teaching; and the same principle, even at this present day, forms the fundamental element of all actual teaching.

"The school which Leonardo da Vinci opened in Florence was intended to be an academy, and had in reality the greatest similarity to our modern idea of such institutions, because the isolated teaching of the old artists' workshops in the middle ages was supplemented and completed by general studies on antiquities, science, and æsthetics. In order to attain to this, Leonardo felt the necessity of writing his immortal treatise on painting.

"The idea of academies belongs essentially to the spirit of the 'Renaissance' period. The return to the study of antiquity had produced a genuine enthusiasm for the institutions of Greece, and Plato's academy at Athens formed the ideal of artists.

"All the academies which made their appearance under the reign of the Medici, during the 15th and 16th centuries, and produced a lively intercourse and interchange of ideas between all men of science and artists, were but the realization of this ideal. This union between science and art produced new researches in the fields of philosophy, nature, æsthetics, and art; and in this grand tournament for the laurel wreath of science and art we see all the distinguished men of the 'Renaissance' and of art enter the lists.

"Who dares to apply to such a movement the word 'decline!' Who would



not rather recognize in this close alliance of spontaneous creation and the researches of free thought one of the most beautiful characteristics of this brilliant revival of arts (renaissance) in the 16th century! As long as art was maintained at its height by the power of some few men of genius, its twofold aim could be attained by isolated masters. At a time when knowledge and inspiration seemed to give to all persons and to all artistic creations one common thought, in order to realize this object, no pedagogical teaching was required; life itself was the school.

“The strength of the traditions of the middle ages was broken, but the ideas of classical antiquity had taken their place, and influenced life, customs, science, and religious belief. It is only natural that they also influenced art. As in this union (*ensemble*) the aim was fixed, there only remained for individuals to search the expression of their feelings in order to arrive at the expression of the general feeling. Thus we see, during this whole period, certain grand artistic creations becoming the models, the examples for all. What had been produced by the common feeling (‘sentiment’) of a whole period naturally was admired by all.

“Thus we see a school of artists form itself round the works of Leonardo da Vinci, the same as round the paintings of Masaccio in the church of Santa Maria del Carmine. Michael Angelo studied there, and after him Raphael did not disdain to borrow from them the types for his own works. The works produced by the competition between Leonardo da Vinci and Michael Angelo for the palace Vecchio, at Florence, became a school for a whole generation of artists. Raphael, leaving for the first time the circle of his school, drew new strength from these studies; one of the grandest compositions of his later days still shows most unmistakably the influence of Leonardo da Vinci, and a century later our great countryman, Peter Paul Rubens, copied the remains of this work that had been saved.

“Let us now examine whether the method of teaching employed in these great epochs did not shorten the time of study by rendering them at the same time more intense. Every workshop, as we have seen, formed, so to speak, a school, where the studies carried on were brought to their most complete development, regarded from a scientific and practical point of view. On entering, the scholar made an engagement of several years with his master, and was received as a simple apprentice, and was at first employed to prepare the palette and the paints; he thus became acquainted with the material procedure, whilst the master and his more advanced scholars initiated him into the practice of drawing, geometry, and perspective. As soon as he was familiar with the labors of the workshop, the master tried to advance his pupil. Then his artistic education really commenced. At first he traced on paste-board the designs of his master, in order to transfer them again to canvas or to the wall; when the master drew from models, the pupil sat by his side and also made a sketch, thus learning to draw from nature, and keep account of the part which must be left to servile imitation in order to arrive at the truth, and of the part which must be left to the imagination, in order to get at the true expression and the style. Another important point was the following: he did not only learn drawing, painting, geometry, and perspective, which made him capable of comprehending architecture, but he was likewise taught modelling.

“How far from this wise practice are we to-day! It is a principle of education, as it has been organized at a later time, that one person learns painting, another architecture, a third sculpture, without any one of them troubling himself in

the least with the other branches of art. I go still further, and maintain that in this country of ours some have even studied sculpture without having learned drawing.

These subdivisions of study are completely unknown in the grand schools of the past. How many great artists have come from the common trades and workshops? It is only since the end of the 17th century that painters ceased to model and sculptors to draw, and since the end of the 18th century they completely ignore everything pertaining to architecture. All the great masters of the '*renaissance*' period were at the same time architects, painters, and sculptors, and one feels considerably embarrassed if he wants to class them under one of these heads; whilst later, during the period of decline, when a painter would have architectural design in his painting, he was obliged to ask the assistance of some architect, and in our days there are those who ignore the study of perspective, and have recourse to a perspectivist for the draught of the work. Where will this system of subdivision stop?

"In former times the pupil had only one desire, viz, to acquire this universality of knowledge which he found in his master, and which was imparted to him all the more voluntarily, because the master could make use of it for his own works. As soon as the pupil had mastered a certain science, the master let him make a rough sketch of his own drawings, arrange some drapery, execute parts of some importance; and as he had an interest in its being well done, he was not sparing in giving advice. Such advice was given at any moment, for the pupil lived the same life as his master, had a place at his table, slept under his roof, and, through a daily increasing intimacy, became completely initiated. The artist was for him not the kind of demi-god, who, according to popular belief, had only to touch his brow in order to make, in a moment of inspiration, masterpieces spring forth from it. No; he was a man eager for universal knowledge; a prey to all human weaknesses, but knowing how to overcome discouragement, rather commencing the same work a hundred times than leaving it imperfect; combining, making trials, undoing and remaking, before giving shape and form to a thought; proud one day and furious or despairing the next; always battling with difficulties. By constant contact with him, the pupil rapidly instructed himself, endeavoring to follow him and to equal him; thus he learned the practice at the same time with the theory, and when he had finished his apprenticeship, then not only his artistic education was complete, but he had likewise drunk deep from the fountain of science, and been thoroughly imbued with those moral sentiments which are essential to every man, and, above all, to the artist; and the master was likewise rewarded by the respect and the consideration of his pupils, who kept alive in him that sacred fire, that love of the beautiful, which had been the constant thought of his whole life.

"This golden age of artistic instruction lasted as long as the rising of the great schools lasted; but as the development and the decline of art does not depend alone on the methods of teaching, but also on the social medium (*milieu*) in which the artists live, nothing could prevent art, like all other expressions of thought, from yielding to the enervating influence which prevailed at the close of the 17th and in the 18th centuries. Diderot writes: 'The degradation of taste, of coloring, of composition, of the character of drawing, has followed step by step the depravation of manners.' And truly the history of art, during that period, corroborates his words, and proves their entire truth. Was it not when Italy dis-



carded all moral sentiment that she lost that royalty in art of which she was so proud? Thus Spain, surrounded by the treasures of America, descended to the very lowest step on the ladder; thus France, when she brought down her painters to the level of her courtesans, made them, during the reign of Louis XV, professors of libertinism. In the same way our own schools disappeared when their powerful painting, ceasing to be the exponent of ideas, was nothing but a bloated and conventional expression, occupying itself only with ordering and arranging. Thus it was that this vast world of artistic individualities became a multitude of insignificant particularities; arbitrariness, flightiness, exaggeration, took the place of that classical dignity based on the consciousness of knowledge; avidity to seize the success of the moment replaced that calm love of the beautiful which formerly reigned at the time of conception of works of art—a sentiment which formed the fundamental character of that flourishing period.

“At that time there awoke in the mind of a serious and well-informed artist a keen feeling of this decline of the arts and the wish to fight against it. That was the time of the foundation of academies in our modern sense of the word. The foundation of the academy at Bologna by Ludovico Carracci was a necessity produced by the consciousness of this decline; it saved art, for on one side the hollow idealism of the mannerists threatened all truthfulness, whilst on the other side a brutal materialism menaced all loftiness, beauty and dignity. Ludovico was joined in realizing this work of reform by his two young nephews, Agostino and Annibale; and animated by a lofty and dignified sentiment, he boldly waged war against his powerful rivals. They commenced their work under sarcasm and contempt, and by an iron energy brought it to the desired end. The school, the teaching of which the three associates had divided amongst themselves, each one taking the part for which he was particularly qualified, finished by attracting all the talent of the other studios, (*ateliers*;) and as they sought to set up again as the only true standard of art truthfulness to nature and life, as well as grandeur and loftiness, they were justly considered the new founders of Italian art. Thus their teaching was free from all forced pedantry, from all systematic rules, preserving at the same time the traditions of style, disposition and *ensemble*, without which no teaching is possible; they could preserve for each individuality his character and his liberty, and it is their greatest glory to have raised up so many artists of original talents, such as Albani, Quercino, Dominico, Lanfranchi, Guido Reni, &c. Thus must be conceived the origin of the academy of Bologna, in which we recognize the first example of those academies which the artistic education of our times requires. Far from having accelerated the decline of art, it has, on the contrary, always fought against this movement, and thus saved art for a new future. The instruction given in these academies had a great advantage over the instruction given by one man in his studio. Art, such as it is to-day, has assumed a general character; it touches everything, and has in the higher spheres of its instruction almost assumed a character of a university education. It is impossible that one man, however great his genius and talents may be, could meet all these varied demands. Can one professor in his workshop (*atelier*) teach philosophy of art, æsthetics, history, literature, technics, perspective—in short, all the various branches which constitute art? This is utterly impossible. The academies here felt this, and have established a system of instruction no longer by one man only, but by a number of men with special talents. This is progress. This organization shows a great development; but at the end of a

certain time, the influence of abuses makes itself felt in the schools, the traditions grow contemptible and art sombre. In the academies you see from time to time a man who resists these invasions, and I find an admirable though little known example of this in our own country. At the Academy of Antwerp, founded by David Teniers, an old professor, endowed with an admirable simplicity and devotedness, Herrens, preserves intact, though all the decline of the 18th century, the technical tradition of Jordaens and Rubens. Herrens traverses this whole unambitious period without in any way yielding to its influence. He is calm and immovable in his work, without allowing himself to be influenced by the evil passions which are at work around about him; and when David, as an exile, fled to this country and made the acquaintance of old Herrens, he said to him: 'If I were young still, I would come to your school and recommence my studies.' This is historical, for I know it from a scholar of Herrens himself. In France, David raised art from the depths into which it had sunk. Only, as at his time the study of the antique was not as much developed as to-day, as the works of Phidias were not known, he could only draw his inspiration from the works of the declining period. Ingres, likewise, drew his inspiration from the antique, but he studied the works of the classical period of Greece; hence the difference between his teaching and that of David. David has nevertheless rendered art immense services. All our most eminent artists have come from his school in passing through that of Van Brée and Navez. I hope that this short historical review has dispelled many erroneous ideas on the nature of academies.

"What other criticisms are made on the academies? Sometimes it is their method of teaching; sometimes the selection of studies; but, as a general rule, all these critics are governed by one thought—that everything one learns besides the mere technicalities is useless for the artist; yea, may even become dangerous for him. Is not this extremely foolish? For an artist, whatever gifts nature may have bestowed on him, must, in order to put them to good use, join the development of his intellectual qualities to that of his technical ones. The progress of his art in that respect ought to be as important as in his natural gifts themselves. History is rich in illustrations of this truth. Look at the art of Greece, the period which preceded the renaissance itself, and modern art! Figure to yourself the great artists of these different periods, those who symbolized the glory of their countries. They were, with few exceptions, remarkable men; men not only skilled in their art, but distinguished by their mental culture, and by the varied character of their knowledge. The more a country rises in the fine arts, the more is felt the necessity of uniting with the technicalities the highest attainments of human science. Knowledge, far from enslaving and fettering talent, only gives to the artist the consciousness of his liberty. We see in the grand classical periods, politicians, philosophers, painters, sculptors, musicians, poets, living in a fruitful familiarity, in a constant interchange of ideas. And what else is the aim of academies if it is not to realize for the artists of our days this ideal? Let us clearly establish the position which art occupies in the field of mental activity of the human race, and the mission of the academies will become self-evident. All mental activity may be divided into three great divisions:

"First, *philosophy*, the foundation of all knowledge, which has a character of universality, and governs every science. It is the heart and centre of it; it is the principle of thought and of reason; the inexhaustible source of universal truths, whose eternal principle is God. Its aim is the search after truth.



“The second division is *art*. Its aim is the free reproduction of the beautiful; not only physical beauty or the beauty of nature, which, alone, would make art merely a servile imitation, but the ideal beauty, such as the human imagination conceives it, by the aid of those gifts which nature furnishes.

“The third division is *science*. Its aim is the search for physical utility. It modifies nature for the benefit of our race by the rational application of its discoveries. It invests man with a true royalty over matter.

“The state ought to offer to all its children the means of acquiring these different expressions of culture, which form its greatness, its development, and its wealth. Therefore we have universities, schools of the fine arts, schools of mining, schools of civil engineering, schools of arts and manufactures. Thus the academies have not been established to form as many artists as possible; they are not destined to guide the taste; but we have academies in order to offer to every individual, who feels within his heart a spark of that sacred fire, the means of arriving at its free and complete development. This possibility, however, can, in our times, no longer be realized by a single master or a single studio. The greatest artist can no longer do justice to this variety of knowledge. For this reason a union of forces has become necessary, just as at the schools and universities. Only in this manner can the multiplicity of wants be satisfied; a way be opened to develop the various talents, and the studies of the workshop (*atelier*) be completed, in order to find the true relation between master and pupil, which is necessary for the proper development of art. The academy gives the instruction; the master seeks out for himself a pupil after his own heart, and the two, by their united efforts, raise an artist. This is, in my opinion, the position which an academy ought to occupy, and which gives the basis for the extent and character of the studies. What can be learned ought to be taught; technics in all its branches, from the fundamental elements to the highest scientific knowledge. In order to attain to this, we must acknowledge that the higher studies in the academies are insufficient; that they ought to be supplanted by studies in æsthetics, history of art, and literature. I said, a while ago, that everything comes to us from the school of David; criticism, however, ought to go side by side with eulogy. I said that everything good with us comes from the school of David; but this teaching is not complete. I would like to add to it two very important elements. I would like to add to the academical and university teaching the teaching in the workshops, (*ateliers studios*.) Some people will say that this wish is chimerical; how can academical traditions and free teaching be united? Nevertheless, this plan is perfectly feasible. It has been carried out at Munich and Dusseldorf, and, by the efforts of M. Violet-Leduc, this system has been organized in the most complete manner in the Institute of France. I will give a striking illustration: In Germany, æsthetical courses are found everywhere; not only at the universities, but also in the schools, and in the most elementary establishments, and a book has just been published entitled ‘*Æsthetische Briefe für junge Mädchen*,’ (Letters on Æsthetics for Young Girls.) In our own country, on the contrary, instruction in æsthetics is almost entirely wanting, and many artists do not even know the meaning of the word. In my opinion, this is not all. I say, first, that the elementary teaching at the academies is insufficient; but the superior instruction likewise is incomplete, not in its course of studies, for that is good, but in its intellectual development, through the great voids which exist. Important higher courses are

entirely wanting in the academies. At none of our universities is there a course of æsthetics. At the university of Louvain a course of Christian archeology has been established, which is only a portion of æsthetics. A course of instruction in the philosophy of the beautiful ought to be established everywhere. At present we see the strange fact that distinguished men, men whom their talents have helped to obtain the first positions in the state, encourage the fine arts and artistic instruction, but, as regards art, are themselves real barbarians. How is the higher instruction organized at Munich; at Dusseldorf; at Paris? An intelligent and learned director superintends the teaching. At Munich, Kaulbach; at Dresden, Schnorr von Caralsfeld. They have a studio, which bears their name. At Munich, there is the studio of Schwind, of Piloty, &c. The pupil chooses the artist whose teaching he prefers; the colorists choose a colorist; the draughtsman, an artist who makes forms a specialty; an artist who possesses fire; a master whose temperament is analogous to his own. The master has a right to accept or refuse a pupil. He can say to the pupil, 'Your studies have been incomplete; go and perfect yourself in the classes.' There is a constant rivalry between the pupils, and also between the professors. Every professor naturally desires to have the most beautiful studio and produce the best results. The pupils are animated by an excellent spirit. They wish to be the strongest at the annual exhibition. All are filled with an emulation worthy of the golden age of art. I will give you an example how the directors understood this sentiment. There was wanting at the Academy of Munich the proper appreciation of color, (*sentiment de la couleur.*) A man who had received instruction in our school of 1830 came to Munich, and there created quite a revolution in art. That man was Piloty. The director having seen this revolution, immediately demanded the establishment of a new studio, and asked Piloty to direct it. Here was a man who understood his mission. The war between the old and the new school broke out, and this war produced, as its result, progress. If one wishes to be sincere, one frankly points out the sore point. In our country there are chiefly two obstacles which prevent the artistic instruction reaching a complete development, viz: the elementary instruction is bad, and the higher instruction is incomplete. The question, therefore, is to produce an organization which is free from these faults. One word more. The government, in endeavoring to develop the higher studies, should also insist on having the artistic instruction at the academies more developed. If we thoroughly examine our present system, we find that there are scarcely two schools where instruction is given in the studios besides the regular instruction in the classes. Such is the case at Antwerp, and to some degree at Louvain. Is it not deplorable that some of the largest cities in the country have no higher artistic instruction? It seems to me, therefore, that certain criticisms made on the academies are greatly exaggerated, but that nevertheless there is every reason for us to put our hand to the work and arrive at a complete organization."

This speech of M. de Taeye was received with loud and prolonged applause; and though several members of the Congress expressed different opinions on some minor points, the great majority thoroughly agreed with him on the urgently needed reorganization of the academies in accordance with the general ideas propounded by M. de Taeye.

*2d Question.*—In the organization of academies of fine arts, that is to say, of special schools for a complete instruction in the arts of design, ought there to be introduced, in view of the demands of industry, a course of artistic instruction, different in some parts from that which art, properly so called, demands? What



ought to be the programme of such instruction? If some parts of this double teaching are in common, where does the separation begin?

After considerable discussion on these questions, the great majority of the assembly agreed as to the urgent necessity of establishing throughout the country, not merely academies and studios, but some rather more democratic institutions for the artistic instruction of workingmen. The aim, as was said, was not to produce thousands of painters and sculptors, but thousands of intelligent workingmen, with some taste for the beautiful in art and nature, and the ability of applying it to their work. Many very able speeches were made, amongst the rest by M. KLEIN, Professor of Architecture at the Royal Academy of the Fine Arts at Copenhagen. He spoke about the different kind of instruction to be given to artists and artisans, both as to matter and method, and finally gave some examples of a school for artisans recently established at Copenhagen.

We give some extracts from the last speech on this question, made by M. JANSSENS SMITS, member of the administrative council of the Academy of St. Nicholas. He said:

“There is not, and there cannot be a difference of opinion as to the end aimed at; everybody is convinced that the talent, devotedness, and the important pecuniary resources which the teaching of the fine arts annually absorbs in Belgium, ought not solely to contribute towards the glory of the country, but also bring new life to all the branches of its activity. One says: Our academies ought not merely to give instruction in the ‘fine’ arts, (*les arts d’agrément*,) as they are commonly called; they ought likewise to popularize the knowledge of the useful arts; the beautiful and the useful ought to be united indissolubly. The grand, the high art does not suffice; we also want the common art. Separated from the useful, the culture of the beautiful does no longer justify the offerings which it claims. These are the arguments of a great number of persons. It will doubtless not be difficult for them to justify the sympathy which they have for arts and industry united, for the good reason that on the most important points they will not be contradicted by any sensible person. Our academies ought, for every pupil who is educated for an artistic career, to form a hundred other pupils for the manual professions. Living in the midst of an essentially industrial population, I would be very guarded in questioning the high and even glorious mission of the arts, and the powerful influence which artistic instruction ought, consequently, to exercise on all industrial productions. But I ask whether the question of *industrial art* does not partly derive its success and popularity from the novelty of its name. The question in itself is old as art, old as work. It is pretension and injustice to believe that this question is so novel. I do not deny that certain improvements might be made in the instruction given in our academies; that certain more direct applications of art to industry might not be attempted; but there are defenders of the new systems, who, it seems to me, are not grateful enough for the immense results obtained by our academies up to this present day; results from which our industrial progress has had its full share. The reformers, with the most excellent intentions and arguments, to contradict which is often very difficult, have, I believe, a tendency to specialize. Can the too divisionary application of art, its application merely to certain local wants—can this be taught without injuring the unity of art; and if this unity were wanting, would it not injure its solidity (*solidité*)? Ought not the principal and most practical aim of this Congress to be to lead to this unity of views, of aspira-

tions, and perhaps, to a certain point, of methods? One of the speakers who preceded me has eloquently and justly remarked: 'Wherever there is matter, there is form; wherever there is form, there is art.' Well, precisely because there are as many expressions of art as there are different forms, and as many kind of forms as there are matters to work upon, I ask whether it is possible to teach professionally all the trades with a view to a special application of art. We cannot follow these infinite classifications in giving instruction. We cannot even theoretically admit thousands of distinct arts; art cannot be broken up into different parts without losing a part of itself. No; there are not thousands of arts; there are not even two different arts; and we go too far, if we speak of an industrial art which ought to differ from another art, doubtless a speculative, abstract and metaphysical one. I only know one art—that is, the idea of the beautiful reproduced in matter; every man who possesses the artistic sense will let its influence be felt in every one of his works; every work which bears this impress of the beautiful is artistic. The classical teaching of our academies has, since their foundation, powerfully contributed to develop this simultaneous culture of the mind and the heart, which constitutes taste; this feeling of distinction; this comprehension of the beautiful. And this taste, this feeling, this comprehension, which might be inculcated into all the classes of the population, if they wished it, have had a decided influence on the general development of our industry. One often speaks of art for all; but does not this specializing imply an abandoning of 'art for all?' It becomes then 'art for some few,' for some one class of workingmen. The true 'art for all' are the unvarying principles, the general notions, which, for ages, have been taught in all our great academies. With the principles once given, pure tastes once inculcated, it remains for the workshop, the factory, the studio, (*atelier*,) to do the rest. I do not hesitate to say that by the experience and education of the industrial workshop, more than by the teaching of some special useful art, Paris has monopolized the trade of the world in almost all articles whose value lies in their artistic taste. The select pupils whom you would educate in your special schools would have to go and complete now their artistic instruction in those Parisian workshops; they would have to form themselves under working artists, not one of whom, perhaps, has ever enjoyed a professional artistic instruction in schools. What is true of the Paris articles is equally true of the flourishing French silk industry, the manufacture of porcelain and crystals. This is true everywhere; and we could find some striking examples in certain Belgian industries. It is by working that one becomes a workingman; it is by making oneself an artisan that one becomes an artist in his profession, if the head has taste and the hand skill. Having to answer those who find fault with the academeal teaching, because it is not specialized with a view to local industry, and who seem to forget the immense and beneficial influence which it exercises on the whole working population, we have already some months ago answered them thus: One loses sight of the fact that instruction in the fine arts, independent of its practical and professional applications, possesses a general usefulness for everything and for all. It is a powerful means of popular education; it exercises on the workingmen an eminently civilizing influence; it polishes his manners and gives him calm and serious tastes; it throws into the young mind a germ of artistic sentiment, which, although it is often denied, is in reality more developed among our working population than among men whose knowledge and taste are lauded everywhere. Let us only for a moment think of the artist painters and sculptors, to whom the lessons received at



our academies open a brilliant career. Let us speak of a more general interest! No; there is not one profession or trade where it is not beneficial to have a tinge of æsthetics; to have trained the eye to the gracefulness and correctness of the outlines; to have inculcated in one's mind a knowledge of perspective, for instance, a science which gives a good deal to think about, and which forcibly leads to it. All these results have in a great measure been attained by our academies; the aptitude of a large number of our workingmen, whose relative inferiority I deny, bears testimony to this fact. In order to convince us of inconsistency, we are accused of too strong a predilection for the special industry of building; our academies are said to be industrial building schools, (*écoles industrielles de bâtisse.*) We are truly astonished to hear it maintained that the study of linear, decorative, anatomical, stereotomic, and architectural drawing, which forms the basis of our popular artistic teaching, will not be of any use to those who will have to handle the compasses, the trowel, and the plane. The value of this appreciation is almost equal to the value of the opinion of those who despise humanitarian studies; who imagine that the study of the higher mathematics is not generally useful; that geometry, *e. g.*, is only good for training land-surveyors.

“Let us not specialize beyond measure! Let us not break the synthetic organization of the study of the beautiful! We admit, *e. g.*, that the application of linear drawing to the drawing of machinery can in many localities be of incontestable usefulness. It ought, therefore, to be an advantage to the workingman to have drawn the mechanisms (*les mécaniques*) with which, in some way, he has to identify himself. The study of models might become to him of great practical usefulness in comprehending and managing his machine or his tool. There will doubtless be other useful applications of drawing and painting without entering on those subdivisions, which are a terror to us; but there are persons who want to specialize, and convert the academies into industrial schools. It would be chimerical to establish, under the cover of fine arts, an academy for armorers at Liege, an academy for lace-makers at Malines, an academy for weavers at Ghent, an academy for cutlers at Namur and Lierre; for manufacturers of delph-ware, at Tournai; for corsetmakers, at Lokren, and academical courses (*sections académiques*) for locksmiths, upholsterers, tailors, seamstresses, and shoemakers everywhere. We can show the greatest care for the success of industry, and favor the introduction of improvements in the teaching of the fine arts, yet at the same time see that it is not practicable to teach as many species (*catégories*) of the beautiful as there are innumerable ways of applying it to the manual professions. By demanding too much, we are misled. The teaching of the ten or twelve great academies of the country has no such urgent need of rejuvenating itself as some seem desirous to prove, and up to the present moment we have not learned that the new methods of our days, which have been praised so much, have discovered a single new line, or that in the combination of lines they have furnished types of a novel and modern beauty which will make us forget the study of the human form and masterpieces of antiquity, from which our old classical teaching obstinately draws its inspirations. Some advocate, in connection with schools of design, special courses of chemistry and physics, in view of the wants of industry. Well, the teaching of chemistry and physics, a knowledge of which, however elementary, aids so powerfully in developing the intellect, and which are of constant practical use to the workingman—the teaching of these sciences, without which all the industrial proceedings can only go on by laborious groping on the

beaten tracks of routine, these purely scientific studies have nothing in common with the development of taste and æsthetical sentiment, to propagate which is the mission of the schools of the fine arts. Far from condemning the study of chemistry and physics, I consider it on the contrary of the highest usefulness, and I believe it to be indispensable to all true progress in industry. I fully appreciate the enlightened solicitude of all those who see in the diffusion of these sciences a means of improving the condition of our workingmen. If we only wish to give to the pupils elementary notions of science in the academies, we supplant the primary schools, for this branch of instruction would naturally find its proper place in the highest class of primary schools. If we wish to give a profound, truly professional knowledge of these sciences, this requires arduous and complete study, which in my opinion is only possible in the great industrial centres, such as Ghent, Liege, Mons, Verviers, which alone can provide the necessary laboratories and collections, a competent faculty, a supply of pupils, and, above everything, the funds which such institutions would require. In some special cases, where a school of design has a surplus of room and funds, I would advise the introduction of these elementary courses. As a general rule, however, I would not advocate it. It is a completely distinct instruction, which, outside of important centres of industrial activity, would most assuredly result in absorbing the few hours of leisure which are left to our workingmen, and in taking away the room, which nowhere is too ample, from the teaching of the fine arts.

“As regards the second part of the question, viz, if some parts of this double teaching are in common, where does the separation begin? I have to say this separation ought necessarily to commence where the artistic side (*côte*) ceases; if not, old academies ought to drop the name, academies of the fine arts; they will remain useful under another and new name; but our mission in being called together here is to purify the taste, to infuse love for the beautiful. Art in itself will exercise an immense influence on the aptitude and the success of the workingman. It is not possible that a good pupil of a good school of fine arts should ever, in whatever branch of industry, become an incapable or awkward workingman. Where his taste and his æsthetic tact have been formed by the classic teaching of art, he will, when at his work, always know how to avoid what is not harmonious, incorrect, or ungraceful. But we will accord more than this to the professional education of the workingman; we desire that there be placed at the service of industry an artistic teaching specialized in a just measure, having in view as much as possible the general wants of industry, and preserving as much as possible the precious unity of teaching. Drawing of machinery, decorative drawing and painting, which, in many cases, can be applicable to manufactures—all this may be excellent; but one should remain within the boundaries of art, in order that the artistic teaching may not degenerate to a cold and inanimate utilitarianism. Let us be prudent in making such experiments, which might suddenly overthrow what we have slowly and laboriously built up. Let us not forget that this would mean a weakening of art, a reducing of its noble mission to what I will call the ‘bare facts,’ the ‘mere mechanical procedure,’ (*du faire, du procédé.*) Above everything, do not let us make of our academies and of their professors, teaching so well and so devotedly, the scape-goats of the weaknesses and the incapacity of certain manufacturers, (*producteurs.*”)

As a longer time than had been originally intended had been taken up by the



discussion on the second question of the second section, the third question could only be briefly mentioned, which could be done all the more easily as, in its import, it very nearly coincided with the first question.

*3d Question.*—Should there be introduced in the academies of the fine arts a course of æsthetics and literature?

Only a few minutes were devoted to this question. We only quote some remarks of M. SLINGENEYER: "There are always certain intervals during the hours of study; thus, a pupil, whilst he studies painting, does not get very tired, and the professor could easily engage him to devote himself during those intervals to certain useful studies; thus, *e. g.*, Homer, Virgil, Shakspeare, Cervantes, would form excellent subjects for reading. In Homer, the artist would find simplicity; in Virgil, rhythm; in Shakspeare, passion. There is no doubt that a judicious selection from the works of these poets would exercise a very happy influence on his artistic education."

*4th Question.*—Would it be useful to found in Belgium, besides the academies of the fine arts, one or more special schools of architecture, where all the studies required for a thorough theoretical and practical knowledge of this art are united, and what subjects should be taught in such a school?

From want of time this question was also treated but briefly. It was very generally conceded that the instruction in architecture, as given at present, was not as full as might be desired; but it was doubted whether the foundation of a central academy of architecture at Brussels, which was all that could be aimed at for the present, could supply this want. M. DE TAEYE cited the example of Berlin, where, as he said, the pupils, on entering upon their studies at the academy, were not asked, will you be sculptors, or painters, or architects; but where they were told: "Learn the language of art, which is drawing; and when you have finished your studies, and know the language well, choose your career—be sculptors, painters, or architects."

*5th Question.*—Among the general means of encouraging the study of the arts of design, should the establishment of competitive (general and local) courses be recommended, how should such competitive courses be organized?

All were agreed as to the usefulness of such competitive courses, and the only question to be settled was, how they should be organized. No speeches of special interest were made, and we only quote some remarks of M. BRAUN. He said: "The method is only an instrument; it is therefore not the method which makes the master, but the master who makes the method. Impose a method upon a master, and you will only retard the progress of his pupils. The professors of the academies themselves should therefore organize these competitive courses, after having deliberated on the subject, as they think best, and the government should certainly do all in its power to encourage these courses."

M. CANNEEL recommended that all the academies should be notified that they were invited to take part in such a competitive course; that at such and such a time each pupil would be called upon to draw such and such a figure, in such and such dimensions, and under such and such conditions. It should be superintended by a person who has no interest in it, that no fraud takes place. Thus, Ghent might be appointed to watch Brussels; Brussels, Antwerp, &c.

After the discussion on this question had been closed, the president read the following proposition, made by 20 members of the Congress, which was received with great applause, and was signed by all; and which, by unanimous consent,

was to be handed to the Minister of the Interior : " The undersigned, members of the Congress for examining into the best methods of generalizing artistic instruction, are of opinion that the progress made by neighboring nations in the realm of fine arts, and in that of the application of art to industry, do not allow Belgium to remain stationary, and therefore hereby express their ardent desire to see established at Brussels, as soon as possible, a palace of the fine arts."

The session of the Congress was closed by a short speech from M. VISSCHERS, the president, in which he said : " I believe I express the wish of the whole assembly that this Congress on instruction in the fine arts may renew itself. We have entered on the realm of the practical, but we are yet far from having exhausted it. I will not predict the future, and cannot say what questions we shall have to discuss at some future meeting ; but if we have restricted ourselves to technical questions, (*enfermés dans la domaine technique,*) if we have not touched the highest questions of art, we shall have been amply indemnified for this by the results obtained by the benefits due to our labors, and we shall grow stronger from these results. If England has shown us what road to travel to reach the highest glory, Belgium will imitate her, and her future glory will outshine her past."

These remarks were received with prolonged applause of approbation. After a unanimous vote of thanks had been passed to the president and the members of the committee of organization, the assembly adjourned *sine die*.



## PUBLIC INSTRUCTION IN MUSIC IN BELGIUM.

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### I.—ROYAL CONSERVATOIRE AT BRUSSELS.\*

THE *Conservatoire Royal de Musique* at Brussels was established by royal decree in 1822, as a school for imparting gratuitous instruction in the whole range of instrumental and vocal music to young Belgians of either sex, and received its present designation by royal decree in 1832.

The branches taught are: 1. Solfeggio and reading music; 2. Singing—solo and concerted; 3. The organ; 4. Stringed and wind instruments and the pianoforte; 5. Thorough bass and accompaniment; 6. Composition; 7. The Italian language and Latin pronunciation; 8. French declamation. There may be, in addition, a class for the plain chant, for acoustics, and for musical æsthetics. A director, professors, supplementary professors, and *répétiteurs*, have charge of the instruction.

The administration of the institution is under the charge of a commission of seven members, including the president, all of whom are named by the king. It chooses a vice-president and treasurer from among its own body. The burgo-master of Brussels is honorary president. The director and secretary, who is also librarian, are not members. The commission proposes to the Minister, jointly with the director, all the officers. It regulates all the expenses, the discipline, and interior economy, and, in consultation, the director fixes the number of *répétiteurs* and pupils in each class. The commission meets once a month, and annually settles the budget of expenses, with the director, and presents a report. Once every three months, at least, the members must make an inspection of the classes. Every member who has been absent from the meetings of the commission for six months ceases to belong to it.

The director is appointed by the king, and can be removed by a ministerial decree. He has the general direction of the studies, methods of study, and the discipline of the classes, as regards both professors and pupils. He may attend the deliberations of the commission, but has no voice in it. He examines and admits or receives pupils, reporting the same to the commission. He has charge of the furniture, instruments, and of the property of the establishment generally. With him, assisted by the professors of singing and instrumental music, rests the admission or the rejection of the candidates.

Candidates for admission as pupils must be able to read and write, and must bring certificates of birth. They must be above seven years old. After twelve they cannot be admitted to the solfeggio classes, unless they can read music. After fifteen they are not admitted to an instrument class unless they show a cer-

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\* Drawn up from Report of M. Duquetiaux, and a Special Report of T. Le Neve Foster.

tain aptitude, and can read music. They can enter the singing classes up to the age of twenty-five, provided they can read music. Those admitted commence their studies the first Monday in October annually. The pupils cannot be absent without leave from the professor, or more than one day in the month without leave from the director, and only for serious reasons. After prolonged absence they are re-examined before re-admission.

The professors and sub-professors are responsible for the conduct of their classes, under the supervision of the director. Leave of absence may be given them for a fortnight by the director; for a month by the commission; for beyond that period by the Minister, under the advice of the director and the commission, but not more than once in the year without the special authority of the Minister. Absent professors are replaced by sub-professors or *répétiteurs*. The former receive the salary of the professors during their absences. If the absence is unavoidable for important reasons, the professor loses only half his salary for the time. If absent for a fortnight or for a month with a medical certificate he loses nothing; beyond that time a quarter of his salary is taken for the benefit of his substitute. Any professor absent without leave or illness is fined two days' salary. Prolonged absence is reported to the Minister, and visited with dismissal or suspension. Professors named by the director take part in the practices and public and private performances. The director chooses the *répétiteurs* from the most distinguished pupils. They have an annual salary, and after two years of approved conduct may succeed to a vacancy as sub-professor. There is an officer termed superintendent of studies, who is responsible for the order of the studies, and for the maintenance of discipline in the classes. He registers and makes a daily report of the presence or absence of the teachers and pupils, and must be present a quarter of an hour before and during the time of study. He has under him servants who attend to the classes, fill the offices of messengers, porters, and orchestra men. He has also the care of the instruments.

The library contains—1. Works on the theory and practice of music for the use of the classes; 2. Scores and separate parts for the concerts; 3. Books and music for the instruction of the pupils and for reference. The advanced pupils may borrow library books with the permission of the director, the same being registered, and for not more than a month.

In the month of May the director commences his examination of all the students in the *Conservatoire* in the presence of the professors in charge of each class. He ascertains the progress made in the year, and how far each pupil has advanced in his education. These examinations, which take place daily, last about six weeks. On the results of these examinations the director determines the dismissal of those pupils who have done nothing during the year. This, however, is rare, for there is a great amount of emulation in the school among the students. The director also determines from among the students those who shall be admitted to the competitions. The director examines all the pupils twice a year, and makes a report to the commission. Each professor and teacher makes a report of the pupils in his class.

The competitive examinations for prizes take place annually in the last week in July, and in the first week in August. After receiving the reports from the professors, the director admits the pupils for competition, and those who are to accompany the solos and conduct the classes. The competitions in harmony and solfeggio are conducted with closed doors. Those for instruments and singing.



in public. A jury of five or seven members is appointed by the commission to award the prizes, of which the director is president. The prizes are given by a majority of votes. In case of an equal number of votes, the director has a second vote.

The names of the successful candidates are published in the newspapers. Each candidate plays or sings one piece at sight, and one which has been previously studied.

The prizes, of which the value is annually fixed by the commission, consist of scores and works on the theory and history of music, collections of music for pianoforte, voice and solfeggio; and to the instrumental pupils bow and wind instruments. The prize-holders receive with the prizes a laurel crown and a certificate. The *accessits* receive a palm. The distribution of prizes takes place if possible in the month after the beginning of the academical year. It is followed by a concert, in which the pupils who have obtained the first prizes are permitted to perform solos. The pupils who obtain the first prizes for their instrumental performances, their singing, their performance on the organ, or for composition, are artists whose education is considered complete, and their studies finished.

The term usually required to turn out an artist of talent, complete, comprising a knowledge of composition, is about eight years. Each pupil gets about six hours of teaching in a week. Concerts are given by the professors and pupils of the *Conservatoire*. The commission fix the number with the director, who arranges the days and the programme, and at the beginning of each academical year he publishes in the school a list of the professors and pupils who are to take part in the orchestra and chorus at concerts. Tickets for the concerts are sold, and the proceeds distributed among the most distinguished scholars. The town councils of the provincial towns are in the habit of paying the expenses of promising pupils, *i. e.*, of those who obtain the first prizes at the *Académies des Beaux Arts* in these towns, in order to enable them to follow the classes at Brussels or Liege.

There are annually two vacations, from Palm Sunday to the first Sunday after Easter, and from the 15th of August to the 1st of October.

The number of professors required in 1865 for 629 different pupils was as follows:

	<i>Professors.</i>	<i>Pupils.</i>
Reading music.....	5	85
Solfeggio.....	{ 3 male } { 3 female }	104
Bassoon.....	1	6
Flute.....	1	5
Cornet.....	1	10
Trombone.....	1	7
French horn.....	1	6
Trumpet.....	1	4
Hautboy.....	1	9
Clarinet.....	2	6
Violin.....	5	69
Violoncello.....	2	25
Double bass.....	1	4
Pianoforte.....	{ 4 male } { 3 female }	114
Singing.....	2	34
Italian language.....	1	14
Organ.....	1	16
Declamation.....	1	20
Counterpoint.....	1	19

	<i>Professors.</i>	<i>Pupils.</i>
Harmony*.....	1	42
Practical harmony*.....	1	19
Accompaniment*.....	1	11
Total.....	44	629

The *Conservatoire* is supported as follows :

	<i>Francs.</i>
Subsidy from the state.....	15,540
“ “ town of Brussels.....	20,000
“ “ province.....	4,500
Fees from foreign students.....	2,500
Total.....	42,540

The expenditure is as follows :

*General Expenses.*

	<i>Francs.</i>
Rent.....	6,200
Music, &c., and books.....	3,100
Pianofortes, furniture, and general maintenance.....	7,120
Total.....	16,420

*Expenses of Tuition.*

	<i>Francs.</i>
Director.....	8,000
Secretary.....	1,700
Superintendent of studies.....	1,380
Two inspectors of do.....	2,440
Accompanyist of studies.....	740
Tuner.....	200
Porter.....	180
Organ-blower.....	150
Twenty-eight professors, from 3,000 <i>f.</i> to 1,170 <i>f.</i> .....	53,190
Six sub-professors, from 950 <i>f.</i> to 600 <i>f.</i> .....	4,500
Eight <i>répétiteurs</i> , at 370 <i>f.</i> .....	{ 3,620
Two “ 300 <i>f.</i> .....	
Two “ 400 <i>f.</i> .....	
Total.....	76,100

The director has a private residence in the building of the *Conservatoire*. The rooms for conducting the teaching of the *Conservatoire* consist of ten class-rooms, and a large room in which the organ is placed. In it also the smaller concerts are given, the larger concerts and the competitive examinations taking place in the Palais Ducal.

The building appropriated to the *Conservatoire* forms a quadrangle, with a garden in the centre. It was formerly the residence of a nobleman, and has been purchased by the government for the use of the *Conservatoire*.

## II.—THE CONSERVATOIRE OF MUSIC AT LIEGE.

The *Conservatoire Royal de Musique* at Liege was established as a school of instruction in instrumental and vocal music in 1827, and received its present designation in 1831. It is supported mainly by an annual grant of \$6,000 from the government, and a subsidy from the province and the town of Liege. The ad-

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\* Two courses.



ministration is committed to a commission, composed of the burgomaster of Liege and eight members appointed by the king. The direction of the studies is confided to a director, whose appointment, as well as that of the professors and substitutes, (27 in all,) belongs to the Minister of the Interior. There is a secretary, a treasurer, and a librarian, (the latter registers the attendance at the classes,) appointed by the commission.

The instruction consists of—1. Musical reading and solfeggio; 2. Singing, individual and collective; 3. Instruments, bow, wind, and keyed; 4. Harmony, and accompaniment from a figured bass; 5. Counterpoint, fugue, and composition. There is also a course of Italian and Latin pronunciation and of French declamation.

All persons intended for the profession have a right to the benefits of the *Conservatoire gratis*, but amateurs must pay 80*f.* per annum. There are scholarships for those who have a decided talent for music, and who can prove that they have not the means of continuing their musical studies without assistance. The inhabitants of the town have no advantage over strangers. The *Conservatoire* is supported by government, but the town gives a subsidy.

The pupils have two lessons a week. Each professor has to attend twice a week for three hours at a time, and this has to be divided equally between all the members in his class, but the number may not exceed twelve.

The report from M. Soubre, the director, states that the number of pupils on his accession to office in 1861 was 258, and in the year 1862–3 reached 498. He considers great benefit to have been derived from the establishment of extra classes for concerted music, one for the organ, and one for declamation. Four concerts were given, in which there were about 220 executants, including 74 instrumentalists. In 1863 the ordinary receipts were :

	<i>Francs.</i>
Subsidy from the state.....	30,440
“ “ province.....	4,000
“ “ town.....	13,000
Produce of the fees.....	2,000
	<hr/>
	49,440
Extra receipts.....	2,652
	<hr/> <hr/>

The expenses were :

	<i>Francs.</i>
Director.....	6,000
Twenty-six professors and several <i>agrégés</i> , (1,200 <i>f.</i> ).....	36,000
Employés, prizes, library, warming, lighting, &c.....	7,440
	<hr/>
	46,440
Extra for instruments, furniture, &c.....	2,652

#### *Programme of Studies.*

1. Class for composition : Study of double counterpoint and fugue ; composition for symphony, dramatic, religious, and so-called chamber music ; analysis of best works of each class. Books : Courses of counterpoint and fugue, by Cherubini and Fetis. Number of pupils, 9.

2. Class for harmony, (male :) Study of harmony, theory, and practice ; exercises written for four voices, four instruments, and pianoforte. Books : Treatise on Harmony, by Catel ; On the Theory of Harmony, by Fetis. Number of pupils, 22.

3. Course of practical harmony, (female :) Studies on the pianoforte, from the “Partimenti” of Fenaroli ; Practical Harmony, by Samuel. The pupils are practised in playing on the pianoforte at sight by score. Number of pupils, 12.

4. Class for bow instruments and piano : Study of duets, trios, quartets, and quintets, by Haydn, Mozart, Beethoven, Schubert, Mendelssohn, and Schumann. Number of pupils, 17.

5. Class for bow instruments : Study of trios, quartets, quintets, &c., by Haydn, Mozart, Beethoven, and Reicha. Number of pupils, 17.

6. Class for wind instruments : Study of trios, quartets, quintets, &c., by Mozart, Beethoven, and Reicha. Number of pupils, 12.

7. Class for concerted singing, (female :) Study of oratorios, dramatic pieces, and religious music, by Handel, Haydn, Beethoven, Mendelssohn, Weber, Cherubini, Schumann, &c. Number of pupils, 55.

8. Class for concerted singing, (boys and men :) The same works as Class 7. Number of pupils, 83.

9. Orchestral practice : Symphonies and overtures of Haydn, Mozart, Beethoven, Mendelssohn, Weber, and Cherubini. Number of pupils, 28.

10 to 14. Classes for solfeggio, (in nine sections :) Elementary study of the intervals ; reading and dictation from the methods of the *Conservatoire* of Paris, the solfeggio of Italy, and the elementary solfeggio by M. Soubre. The upper department practises change of clefs, and further study of the theory of music. Number of pupils, 176.

15 and 16. Singing classes for men : Study of vocalization, dramatic and religious pieces ; methods of the *Conservatoire* of Paris and Manuel Garcia ; vocal studies by Crescentini, Bordogni, and Masset. Number of pupils, 23.

17 and 18. Singing classes, (female :) Same studies. Number of pupils, 23.

19 to 22. Classes for pianoforte for young pupils : Gradual studies, up to the execution of the works of Hummel, Weber, Beethoven, Mendelssohn, Chopin, Listz, &c.; methods of Adam, Kalkbrenner, and Fetis ; Encyclopædia of the Pianoforte, by Zimmerman. Number of pupils, 41.

23 to 29. Classes for pianoforte, (male :) Same studies. Number of pupils, 70.

30 to 34. Classes for violin : From the beginning, to the execution of concertos by Viotti, Rode, Kreutzer, De Beriot, Vieuxtemps, Ferdinand, and David ; methods of Baillot and De Beriot. Number of pupils, 41.

35. Class for violoncello : From the beginning, to the practice of the works of Romberg, Molique, Servais, &c.; methods of Romberg, Baudiot, Dotzauer, &c. Number of pupils, 7.

36. Class for double bass : From the beginning, to the practice of the concertos by Labro ; methods of Labro, Bernier, and Wencelas Hause. Number of pupils, 5.

37. Class for the organ : From elementary playing to the practice of the fugues of Bach ; sonatas, by Mendelssohn ; study of the accompaniment of the plain chant. Number of pupils, 8.

38 and 39. Classes for declamation : Exercises in articulation ; reading aloud from select works ; dramatic exercises. Number of pupils, 22.

40. Class for the flute system of Walkiers. Number of pupils, 11.

41. Hautboy class : Methods of Sellner and Brod. Number of pupils, 5.

42. Clarinet class : Methods of Lefevre, Beer, and Muller. Number of pupils, 8.

43. Bassoon class : Methods of Ozi and De Willent. Number of pupils, 6.

44. French-horn class : Method of Gallay. Number of pupils, 7.

45 and 46. Classes for the trumpet and cornet-a-piston : Methods of Schiltz and Forestier. Number of pupils, 21.

47 and 48. Classes for the trombone and tuba : Method of Schiltz. Number of pupils, 14.

Total number of pupils, 743. In the classes from No. 40 elementary instruction is included as well as the most advanced.

### III.—CONSERVATORY OF MUSIC AT GHENT.

The Conservatory of Music at Ghent, which does not receive aid from the government, numbered, in 1865, 308 pupils, of whom 84 were females.



## IV.—COMPETITION FOR PRIZES FOR MUSICAL COMPOSITION.

This takes place at Brussels every two years, and is open only to natives of Belgium, who have completed their thirtieth year at least, and have been admitted to compete after a preliminary examination by the jury of award. The jury is composed of seven members, four of whom are appointed by the King on the nomination of the Minister of the Interior, and the rest by the fine arts section of the Royal Academy, from the members of the department of music.

The competitors compose a dramatic scene upon a given subject.

The first prize is an annuity of 2,500 francs during four years, which time is to be spent in studying music in France, Germany and Italy.

There is a second prize, a gold medal of 500 francs, and an honorable mention. Both can be divided.

Government also institutes a prize competition for those poems which it requires.

## V.—SCHOOLS AND SOCIETIES OF MUSIC IN BELGIUM.

Besides the three superior conservatories, there are in Belgium a great number of public and private societies and schools, having for their aim the cultivation of music, besides the constant attention which is paid to vocal and instrumental music in the primary schools and other educational establishments.

At Antwerp there is an academy of music, under three professors, paid from the public funds, providing for the instruction of forty children selected from the public schools.

The courses are divided into three parts, in each of which instruction is given in elementary singing, the violin, the piano, the organ, and in harmony. Similar institutions have been established at Malines, Brussels, Bruges, Spres, Oudenarde, Alost, &c. Each regiment in the army has its band, and several possess societies of choral music in addition. To sum up, we find in a recent statement (August, 1851) of the Department of the Interior, that there are in the kingdom 461 societies of instrumental music, counting 12,397 performers, and 258 societies of vocal music, with 7,062 performers. Of these societies 165 were organized before 1830; 116 between 1831 and 1840; 193 between 1841 and 1847; and 245 between 1848 and 1851. Many of the societies of instrumental music are either wholly or in part societies of vocal music also. We subjoin a table of these societies:

PROVINCES.	Societies of Instrumental Music.		Societies of Choral Music.		Periods of formation of Societies.			
	Number.	Performers.	Number.	Performers.	Before 1830.	1831 to '40.	1841 to '47.	1848 to '51.
Antwerp.....	39	1,115	16	541	19	9	16	11
Brabant.....	72	2,176	42	1,170	21	21	34	38
East Flanders.....	59	1,545	17	483	30	17	13	16
West Flanders.....	95	2,542	64	1,853	39	32	46	42
Hainault.....	95	2,415	70	1,855	29	17	49	70
Liege.....	23	614	23	592	7	7	10	22
Limburg.....	25	729	3	67	6	1	7	14
Luxemburg.....	15	377	3	67	6	2	3	4
Namur.....	38	884	23	501	8	10	15	28
Total in the kingdom..	461	12,397	258	7,062	165	116	193	245





## SPECIAL INSTRUCTION IN HOLLAND.

### INTRODUCTION.

THE Kingdom of the Netherlands consists of the territory of the ancient seven United Provinces and a portion of the province of Limburg, and comprises about 12,000 square miles, with a population in 1868 of 3,628,229, of which the protestant population is about 60.6, and the catholic 37.3.

The industries of Holland are diversified—agriculture, commerce, fishing, the trades, and manufactures, each employ large portions of the population and give everywhere occupation, and concentrate the inhabitants into villages and towns, which admit of the principle of coöperation for educational as well as other purposes.

The system of public instruction has for more than a half century attracted the attention of her own statesmen and educators, and is now organized and administered with great efficiency, under the minister of the interior, who acts through an inspector-general and seventy assistants. The system embraces :

1. *Primary Schools.* Of these there were in 1865, 2,565 public primary schools, under 6,678 teachers, with 343,005 pupils ; 152 aided private primary schools, under 310 teachers, with 5,996 pupils ; 906 unaided private primary schools, under 3,243 teachers, with 83,412 pupils ; making a total of 3,623 schools, with 10,230 teachers, and 432,383 pupils. Of the whole number of primary schools, 991 were of a superior grade, more than one for every large town. There were also 784 infant schools ; 152 repetition schools for adults ; 118 secondary schools for apprentices ; 127 singing schools ; and 23 schools for gymnasts.

2. *Secondary Schools.* Under the new organization of 1865, there are 20 higher burgher schools, with 219 teachers, and 1,466 scholars ; 61 gymnasia, including 33 Latin Schools, with 101 teachers, and 1,214 scholars.

3. *Superior Schools.* There are 3 universities, with an aggregate of 1,297 students, under 75 professors ; besides institutions at Amsterdam, Deventer, Maastricht, and Roermond, which are not classed with the universities, but give lectures and courses of instruction beyond our American colleges, to upwards of 500 pupils.

4. *Special Schools.* These are abundant, but have only been brought into systematic organization by the law of 1865. There were in 1868 :

3 Teachers' seminaries, with 187 students ; 27 schools of the highest grade, with a normal course, in which 998 pupil teachers were acting as assistants ; 57 schools with a normal course, and 706 pupil teachers for primary schools acting as assistants ; and 7 girls' schools, with 76 female pupil teachers acting as assistants.

- 1 Polytechnic school, at Delft, with 104 pupils.
- 1 Military school, at Breda, with 320 pupils.
- 1 Naval school, at Williamsoord, with 53 pupils.
- 1 Cadet school for the marine corps, at Amsterdam.
- 1 School for boatswains at Williamsoord, with 48 pupils.
- 1 School for pilots and helmsmen on guard-ship, at Amsterdam, with 255 pupils.
- 10 Schools of navigation, with 690 pupils.
- 1 School for steam engineers, with 10 pupils.
- 1 School for the sanitary corps of army and navy.
- 2 Schools of commerce and trade, with 120 pupils.
- 1 Agricultural academy, with 14 students.
- 1 School of veterinary surgery.
- 1 School of midwifery, with 26 pupils.
- 2 Chemical schools, besides the five faculties of medicine in the universities and athenæums.
- 2 Oriental languages, geography, &c., with 71 students.
- 3 Institutions for deaf mutes, with 350 pupils.
- 1 Institution for the blind, with 96 pupils.



## SYSTEM AND INSTITUTIONS OF SPECIAL INSTRUCTION.

Although institutions of a special practical aim have existed for many years in Holland, there was no general legislation reaching them until 1863, when the law on secondary instruction was framed and passed. By this law provision is made for—

1. Burgher-schools, which are divided into—
  - (a) day or evening schools, and
  - (b) higher schools of three or four classes.
2. Agricultural schools.
3. A Polytechnic school, for civil engineers, architects, ship-builders, and mechanics.

## BURGHER DAY AND EVENING SCHOOLS.

The lowest degree of industrial instruction is given in connection with the "burgher day or evening schools." Originally these existed as schools for drawing, designing, and modeling, but theoretical and general courses have been combined with them, producing the present establishments. They receive pupils on leaving the primary school. The course lasts two years, the studies pursued being mathematics, theoretical and practical mechanics and machinery, physics, chemistry, natural history, technology, or agriculture, or both; geography, history, Dutch, political economy, ordinary and geometrical drawing, and gymnastics. It rests with the local authorities whether technology or agriculture or both shall be taught. Modeling and French, English or German may be added.

The maximum fee for tuition is \$5,00 per annum, the remaining expenses being borne by the communes.

## HIGHER BURGHER-SCHOOLS.

For that degree of industrial instruction required by masters, overseers, merchants, and all those not intended for the army or navy or one of the learned or high technical professions, provision is made in the curriculum of the Higher Burgher-schools with three and five-year courses, especially in the latter. The course pursued in them includes good general as well as technical instruction.

These schools are subsidized by the government, those with three classes receiving about 2,100 dollars per annum, those with five classes about 2,850. The maximum annual fee is \$25,00.

In the schools with a three years' course are taught mathematics, physics, chemistry, botany, zoölogy, political economy, book-keeping, geography, history, Dutch, French, English, and German, calligraphy, ordinary and geometrical drawing, and gymnastics. Those with five years' course add mechanics, machinery, and technology, mineralogy, geology, cosmography, the principles of the municipal, provincial and central government of the Netherlands, political economy and statistics, especially of the Netherlands and its colonies, the literatures of the languages studied, the rudiments of commerce, and the knowledge of raw and wrought materials. The sciences, only pursued in an elementary manner during the three years' course, are in the five years' course carried farther.

## AGRICULTURAL SCHOOLS.

The law provides for the foundation of one government agricultural school, if desirable. Private agricultural schools may be subsidized by the government. In them are taught political economy, practical mathematics, such as surveying and measuring, mechanical science and instruction in agricultural machines, the construction and arrangement of farm-buildings, physics, chemistry, meteorology, mineralogy, geology, all applied to agriculture, agricultural technology, botany, zoölogy, domestic animals, their races and diseases, with the treatment of the latter, agriculture in all its branches at home and in the colonies, cattle and poultry, bees, and farm book-keeping.

There is an agricultural school at Groningen, originally projected by an association of agriculturists, but subsidized by the government. The entire course embraces three years, but single courses may be attended on the payment of certain fees.

## POLYTECHNIC SCHOOL.

The highest technical instruction is to be obtained at the Polytechnic School, which forms young men for various industrial and technical pursuits requiring a more advanced degree of training than is afforded at the burgher-schools. It bestows diplomas in technology, civil engineering, architecture, naval engineering, mechanics, and mining.

The technical studies are thrown upon the last two years. The students accompany the teachers on visits to the neighboring manufactories and industrial establishments. The final examination is conducted by a commission composed of the director and teachers, the teacher of gymnastics not being included. The pupil can choose to be examined in either agriculture or technology.

The school receives from the government a subsidy of about 4,250 dollars per annum, and the maximum fee of a scholar is about 25 dollars, in addition to which he furnishes his own books and school necessaries.

## HIGHER BURGHER-SCHOOL AT MAASTRICHT.

The higher burgher-school at Maastricht is intended to give a fair degree of general and industrial instruction to all not intending to pursue the higher technical professions. It is subject to the inspection of a local board, who report to the magistrates, by whom they are appointed, and to certain inspectors commissioned by the crown, who report to the Minister of the Interior. It admits boys about the age of twelve or thirteen, no special qualification for admission being required. The staff of instructors consists of a director and eleven teachers, who are appointed after a general examination, and with special reference to the branches which they are to teach; they hold a diploma in those branches from a university.

The course extends through five years, with eight weeks' holidays every year, and embraces German, history, geography, mathematics, geometrical drawing, gymnastics, and the manual drill; from the second to the fifth, drawing and English; from the third, physics; from the fourth, chemistry, political economy, and cosmography; during the first year only, calligraphy; during the first and second, natural history; during the fourth, mineralogy; during the fifth, mechanics, technology, and commercial science.



## INSTRUCTION IN AGRICULTURE AND RURAL ECONOMY.

The law of 1863 provides for the foundation of one State agricultural school, and the extension of government aid and inspection to private establishments. The subjects of study prescribed for this class of schools, whether public or private, are:

- a. Political economy.
- b. Practical mathematics, such as surveying, leveling, and mensuration.
- c. Mechanical science, as applied to agriculture, and instruction in agricultural machines.
- d. The construction and arrangement of farm buildings.
- e. Geometrical drawing as applicable to agricultural science and machinery.
- f. Natural science, (physics,) chemistry, and meteorology, in their application to agriculture.
- g. Agricultural technology.
- h. Mineralogy and geology in their application to agriculture.
- i. General and special botany and zoölogy.
- k. The anatomy and physiology of plants and animals.
- l. The distinguishing characteristics of the various races, diseases, and medicinal treatment of domestic animals.
- m. General and special agriculture, arable land, meadow land, vegetable and fruit gardening, and rearing of timber and fruit trees.
- n. Rearing of cattle, including domestic poultry, bees, and dairy produce.
- o. Farm book-keeping.
- p. Practical farming, including cultivation of woods and forests, and treatment of domestic animals.
- q. Farming in the colonies.

## AGRICULTURAL SCHOOL AT GRONINGEN.

The agricultural school at Groningen was founded by "The Society for the Advancement of Agriculture," and aided by private individuals interested in the enterprise. It was opened November 1, 1842, with 8 scholars. The attendance has never been large, but has always been steady, and scholars have come from all parts of Holland and even from the Dutch colonies. Since the opening of the school, [till 1867,] 322 scholars have attended it. The number of students in June, 1867, was 14, and the number of professors 10. The number of books and pamphlets on agricultural subjects published by former pupils of the school amounted in 1867 to 167.

The course of studies extends through four years and embraces the following subjects:

*First year.*—Geometry, book-keeping, physics, zoölogy, botany, algebra, social and agricultural economy, knowledge of agricultural implements, linear and free-hand drawing, colonial agriculture, chemistry, French. *Second year:* The same subjects, and in addition, geography, horticulture, special agriculture and management of dairies.

During the *third* and *fourth* years the same subjects are continued. There is a winter and a summer course. During the summer, practical studies are gone through on land bought for this object in the neighborhood of Groningen.

The affairs of the school are managed by a board appointed by the "Society for the Advancement of Agriculture," from among the more prominent landed proprietors. The general government gives the annual sum of 1,000 florins, and permanent contributions are likewise received from the provincial governments and private persons.

There is a small museum and a library attached to the school.

The instruction-fee, which must be paid annually in advance by every pupil, is 40 florins for the first year and 20 florins for every succeeding year.

PROGRAMME OF STUDIES AT THE AGRICULTURAL SCHOOL OF GRONINGEN.

*First Year, (Winter Course.)*

	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
A. M.						
9.	Geometry.	Botany.....	Chemistry.	Social economy.	Chemistry.	
10.	Chemistry.	.....	Rectilinear drawing.	Agricultural economy.	Algebra.	Geometry.
11.	Book-keeping.	Zoölogy.....	Rectilinear drawing.	Agricultural economy.	.....	French.
12.	Knowledge of agricultural implements.	.....	Natural philosophy.	Drawing.	Natural philosophy.	Natural philosophy.
P. M.						
1.	Social Economy.	.....	.....	Drawing.	Colonial agriculture.	Zoölogy.
6.	Applied chemistry.	Applied chemistry.	.....	at 4 o'clock, }	Domestic animals.	

*Second Year.*

	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
A. M.						
9.	Chemistry.	Botany.....	Chemistry.	Geography.	Chemistry.	Horticulture.
10.	Chemistry.	Book-keeping.	Zoölogy.....	Agricultural economy.	Chemistry.	Practical chemistry.
11.	Natural philosophy.	Knowledge of agricultural implements.	Special agriculture.	Agricultural economy.	Natural philosophy.	Practical chemistry.
12.	Social economy.	Knowledge of agricultural implements.	Special agriculture.	Drawing ...	Management of dairies.	
P. M.						
1.	Horticulture.	Geography.	Agricultural implements.	Mathematics.	Colonial agriculture.	Implements.
6.	Applied chemistry.	Applied chemistry.	.....	4 o'clock, }	Domestic animals.	

*Third and Fourth Year.*

	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
A. M.						
9.	Chemistry.	Botany.....	Applied mathematics.	Geography.	Agricultural implements.	Practical chemistry.
10.	.....	Book-keeping.	.....	Agricultural economy.	Chemistry.	Practical chemistry.
11.	Geography.	Agricultural implements.	Special agriculture.	Agricultural economy.	Agricultural practice.	Practical chemistry.
12.	.....	Agricultural implements.	Special agriculture.	Drawing.	Management of dairies.	
P. M.						
1.	Applied zoölogy.	Geography.	Botany.....	Agricultural chemistry.	Colonial agriculture.	Agricultural chemistry.
6.	Applied chemistry.	Applied chemistry.	.....	5 o'clock, }	Domestic animals.	



## THE ROYAL POLYTECHNIC SCHOOL AT DELFT.

The Royal Polytechnic School at Delft is intended to train those who require "a higher degree of technical and theoretical knowledge than is obtainable at the higher burgher-schools, and for the education of civil engineers, (from whom the government engineers are selected after competitive examination,) architects, naval engineers, ship-builders, mechanics, and engineers for the mines."

It will be observed that the training of good civil engineers is of vital importance to this country. Many acres have been rescued from the ocean and are kept from its ravages only by untiring watchfulness, while the inundations of the Rhine and Meuse annually threaten large districts with destruction.

Pupils are admitted after a previous examination, from which, however, those are exempted who bring diplomas from the burgher-school of five classes.

The studies pursued are the following: algebra, spherical trigonometry, analytical geometry, descriptive geometry and its applications, differential and integral calculus, surveying, leveling and surface measurements, theoretical and applied mechanics, machinery, mechanical technology and agricultural machines, applications of natural science; applied, practical, and analytical chemistry, chemical technology, modern manufactures, mineralogy, geology, metallurgy, applied geology and working of mines, hydraulics; road, railroad, and bridge building, civil architecture, ship-building, geometrical drawing, practical instruction in the use of tools, instruments, and the turning lathe, construction of models, political economy, commercial law, and laws relating to engineering, public works, mining, and all industrial works.

Diplomas are granted after three examinations before a board of commissioners appointed by the Minister of the Interior, in technology, civil engineering, architecture, naval engineering, mechanics, and mining engineering.

These examinations are thorough and special. The first is common to all, and proves that those who pass it successfully have attainments superior to the graduates of the Higher Burgher Schools. The second is in the main common to all, and covers algebra, trigonometry, geometry, and the calculus, and the first principles of chemistry, mechanics, and drawing, both free-hand and geometrical. The third is special, and searching, and turns on the practical applications of the principles of science to the special career on which the candidate proposes to enter.

The number of students was 104 in 1865. The fees are about 80 dollars per annum, the cost of books and instruments being additional. Students are admitted, at regular rates, to attend single courses.

The *Times* correspondent, in describing the educational section of the recent (1869) Amsterdam Art Exhibition, remarks:

A large aisle of the building is filled with plans, sections, drawings, models, straw-plaiting of the different trade schools organized under the law of 1863. Nearly every trade is represented: Zaandam with clay models for house decorations; Deventer with wood-carving; Breda with excellent work in wood and straw from an industrial school for girls; Rotterdam with sections and elevations of building plans. Here too were some curious and suggestive works by little children trained on Fröbel's system. And all this great system of general and special education has grown out of the Public Good Society, started by a few clergymen in 1784, which has now 200 branches and 14,000 members.

## NAVIGATION SCHOOLS FOR THE MERCANTILE MARINE.

There are ten special Navigation Schools (besides a nautical division in the Academy at Groningen) located in the principal commercial ports, and among the sea-going population. They are generally under the management of local mercantile societies, but subject to government inspection, and final examination, on which the rank of the graduates as first, second, and third mate, depends.

The pupils are admitted on examination in the elementary studies, physical ability, and aptitude for sea-service.

The course in the best schools embraces, besides a review of the elementary branches, a knowledge of geography, especially of the climate and products of different countries; mathematics, including trigonometry, nautical astronomy, practical use of instruments at sea, and the calculation of latitude and longitude, a knowledge of the code of signals, the laws of storms and tides, mercantile laws and usages, and practice in letter-writing, keeping the ship's books, and chart-drawing.

Opportunities of practice are secured on vessels in port, in coasters, and even long voyages to the West and East Indies.

Ability to hold the rank of mates depends on the results of the final examination, and promotion from one position to a higher depends on successive examinations, after leaving the schools.

The statistics of attendance at these schools in 1867 were as follow:

Rotterdam, 133 pupils; Leyden, 87; Amsterdam, 87; Amsterdam, 18; Harlingen, 59; Nes, 19; Schiermonnikoog, 84; Vundam, 37; Groningen, 85; Delfzve, 68; Nautical section of the Groningen Academy, 39.



# PUBLIC INSTRUCTION IN DENMARK.

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## INTRODUCTION.

THE kingdom of Denmark, on an area of 14,533 English square miles, [exclusive of Iceland and the Faeröer, which have an area of upwards of 40,000 English square miles] in 1869 had a population of about 1,800,000. Out of an average of 1,000 people, 395 live exclusively by agriculture, 228 by manufactures and trades, 187 are day-laborers, 53 are commercial men, 29 mariners, 20 paupers, 16 ministers and schoolmasters, 15 pensioners, 13 servants, between 11 and 12 hold appointments in the civil offices, 9 are commissioned and non-commissioned officers, 9 capitalists, 7 follow scientific and literary pursuits, about 5 have no fixed means of living, and a little over 1 are in prison for crimes and misdemeanors.

The total annual expenditure of the government of Denmark for the financial period 1866-67 amounted to 23,529,021 rix-dollars (1 rix-dollar=54 cents.)

The institutions of public instruction, with the exception of the military and naval schools, are administered by the Minister of Public Education and Ecclesiastical Affairs, and include :

1. *Primary Schools*.—There are 2,520 primary country schools, with 2,630 teachers and 162,000 pupils, and 120 town-schools, (with elementary and higher classes) with 294 teachers and 16,120 pupils. In the city of Copenhagen there were about 160 (public and private) primary and primary superior schools, with 24,684 pupils (in 1867.) There is, besides, at Copenhagen a royal school of reward (for children of the royal servants) with 40 pupils; and in all the large villages, infant and primary schools, under private teachers and family auspices. The total number of elementary schools is reported to be 2,940, with 202,800 pupils, under 3,080 teachers.

2. *Secondary Schools*.—There are, including Iceland, 17 gymnasia, some classical and some with real-classes, with 2,190 pupils.

3. *Superior Schools*.—The university at Copenhagen, founded in the year 1478, has four faculties, viz., theology, law, medicine, philosophy, mathematics and natural sciences; 52 professors, and about 1,200 students (in 1868.) Connected with the university are a chemical laboratory, a botanical and a zoölogical garden, a museum of natural history, an astronomical observatory, and a library of 230,000 volumes and 4,000 manuscripts. The Royal library contains 500,000 volumes and 20,000 manuscripts. There are at Copenhagen a large ethnographical museum, a constantly-increasing collection of Northern antiquities, forming already now the largest museum of the kind in the world; 2 galleries of art, and the Thorvaldsen museum, containing all the works and collections of the great sculptor.

4. *Special and Professional Schools.*—Of these there are the following:
- 1 Royal academy of agriculture, forestry, horticulture and veterinary surgery (*Den Kongelige Veterinair-og Landbo-hoiskole*), with 16 professors and 284 students.
  - 1 Polytechnic institute, with 15 professors and 214 students.
  - 1 Technical institute, with 5 professors and upwards of 600 pupils.
  - 1 Royal academy of the fine arts, with 10 professors, 8 assistants, and 600 pupils.
  - 2 Commercial academies (private) at Copenhagen.
  - 5 Teachers' seminaries, with 31 teachers.
  - 1 Institute for the blind, with 8 teachers.
  - 1 Institute for deaf-mutes, with 10 teachers.
  - 1 Naval cadet-academy, with 16 professors and 25 pupils.
  - 8 Navigation schools (private.)
  - 1 Military academy, with 13 professors and 30 pupils.
  - 1 Military school of gymnastics.
  - 1 Military riding and horse-shoeing school.



## SPECIAL SCHOOLS OF DENMARK.

The scientific schools of a special character exist in Denmark as follows :

## 1. Agriculture and allied branches :

The Royal Veterinary and Agricultural School near Copenhagen.

## 2. Architecture, the mechanic arts, &amp;c. :

- (1.) Polytechnic Institute at Copenhagen
- (2.) Royal Academy of Fine Arts at Copenhagen.
- (3.) Technical Institute at Copenhagen.
- (4.) Sunday Improvement Schools at Copenhagen.

## 3. Navigation and Commerce :

- (1.) Schools (8) of Navigation, at various places.
- (2.) Academies (2) of Commerce at Copenhagen.

## ROYAL VETERINARY AND AGRICULTURAL SCHOOL AT COPENHAGEN.

The Royal Veterinary and Agricultural School, at Copenhagen, was founded by a law of March 8th, 1856, for the purpose of educating veterinary surgeons, land inspectors, surveyors, foresters, gardeners, and farmers.

Pupils are admitted after a preparatory examination, from which, however, those who have graduated from a real school, gymnasium, teachers' seminary or military school, are excused. Auditors also are admitted without being obliged to be examined.

The academical year begins August 23d. The school is divided into five departments, for veterinary surgeons, farmers, land inspectors, gardeners, and foresters, each pupil pursuing only those studies pertaining to his own department.

## I. VETERINARY ART.

The course extends over two years and a half, with a fundamental or general section, a special technical section, and a practical section.

*General section.* Physics; mechanics, equilibrium and pressure of solids, liquid and gaseous bodies, motion, heat, magnetism, electricity; optics, reflection and refraction, optical instruments, polarization and interference. Meteorology applied to the phenomena of daily life. Chemistry; general and applied inorganic and organic chemistry. Botany; vegetable anatomy and physiology; natural and Linnaean methods, with practical exercises in determining plants by both. Applied botany; nutritious plants for man and the domestic animals, medicinal plants, weeds; trees; weekly botanical excursions in summer, beginning in May. Zoology; organic system; natural history and breeding of domestic animals; zootomy.

*Technical section.* Anatomy; special anatomy and organization of animals, especially of the domesticated races. Physiology; physiology of domestic animals in a state of health, and the functions of their various organs, in development, preservation of life and reproduction. Breeding, care, and use. Dietetics. Pharmacology and pharmaceuticals. Diseases; pathology and therapeutics, surgery, obstetrics, exterior diseases, duties of State veterinary surgeons.

*Practical section.* Theory and practice of horse-shoeing; diseases of the hoof; dissections; obstetrical operations; clinique; cleaning, breaking, and management of horses; equipment of the horse, reports on health, &c.

## II. AGRICULTURE.

The course covers twenty-one months.

*General section.* The same as for the veterinary course.

*Technical section.* Agriculture; history of the art in Denmark; agricultural implements; farm; dairy; general treatment of plants; pasture and wild land; cultivation of the most important plants. Analytical chemistry, with manipulations in the laboratory; qualitative and quantitative analysis; salts, earth, manures, feed, &c. Theory of farming; formation of soil; minerals, stones, &c.,

adaptation of soil to the growth of plants; general and chemical qualities; scientific improvement of the soil; drainage; periods of planting; care, use, and diseases of domestic animals; farming accounts. Surveying and leveling; draughting and mapping; use of instruments.

*Practical section.* Practice in farm, dairy, and laboratory.

### III. LAND INSPECTION AND SURVEYING.

The course embraces twenty-one months, and besides certain branches included in the preceding course, instruction is given in mathematics, geometry, geometrical drawing, surveying and use of instruments, mapping, legal division of land, laws on agriculture, principles of agriculture, soils, filling, and drainage.

### IV. GARDENING.

The course lasts twenty-one months. In common with the other departments the following studies are pursued: physics, meteorology, chemistry, botany, agriculture, surveying, leveling, and draughting. The special branches are the theory and practice of horticulture, plans of garden tools, principles of geometrical construction and projection.

### V. FORESTRY.

The course in forestry embraces two and three-quarter years. The students participate in the general course for farmers, veterinary surgeons, and surveyors, but carry botany and zoology farther, investigating forest trees, birds, insects, &c. The technical part of the course embraces technical, economical, political, and practical forestry with hunting.

*Table of Attendance in 1866-7.*

Nativities.	Veterinary.	Farming.	Land inspecting.	Forestry.	Gardening.	Other Students.	Totals.	Course in Blacksmithing.
Kingdom of Denmark, -	127	42	17	5	31	16	238	14
Duchy of Schleswig, -	15	7	1		1	1	25	
Duchy of Holstein, -	3						3	
Kingdom of Sweden,		2					2	
Kingdom of Norway, -	14		1				15	
Province of Finland, -		1					1	
Total, - - -	159	52	19	5	32	17	284	14

Of the 238 pupils from Denmark, in the above table, 46 were graduated. Those of the graduates in veterinary art receiving certificate No. I were 11, No. II 16, No. III 4; in agriculture No. I 2, No. II 3; in inspecting, No. II 2, No. III 2; in gardening, No. I 1, No. II 1; in forestry, No. I 1, and No. II 3.

The fees are two dollars (Danish) at matriculation and seven for examination, the lectures being charged as follows: Semi-annually, two lectures a week, two dollars; semi-annually, three lectures a week, three dollars. For materials in laboratory six dollars for first half year and ten for each subsequent half year, for honorary pupils fifteen. Surgical operations three dollars per half year, ambulatory clinique six dollars. Surveying practice two dollars per half year, five for surveyors and foresters. General cards of admission to lectures five dollars.

The annual expenses of the institution are about \$27,000, most of which is met by the State. The original appropriation for the buildings was about \$170,000. Among the ordinary annual charges may be noticed about \$1,000 for the experimental kitchen garden, nearly \$1,100 for the scientific or botanical garden, and \$700 for the chemical laboratory.



## THE MASSMANN SUNDAY SCHOOLS AT COPENHAGEN.

The Massmann Sunday schools were established May 4, 1800, by the efforts of Rev. J. Massmann. Their aim is, to procure for neglected boys and adults, instruction in arithmetic, writing, orthography, book-keeping, and correspondence, and for apprentices instruction in drawing and other practical branches.

The entire number of persons who have obtained instruction in these schools since their establishments, down to 1854, was as follows: Master mechanics and artisans, 118; workmen, 2,300; apprentices, 10,529; other persons, 260; young criminals in the house of correction, 827; total, 14,034.

The schools are under the management of a society, whose members oblige themselves to do such service as they are appointed to in superintendence of the instruction, in the annual examinations, and in collecting subscriptions for the maintenance of the schools.

The society has one chief director and five sub-directors, chosen from among their number for three successive years. The directors appoint teachers, who are paid by the society, at the rate of four Danish dollars per month, for two or three hours' instruction every Sunday, with the exception of church-holidays, from 6 to 9 A. M. in the summer, and from 4 to 7 P. M. in the winter.

## TECHNICAL INSTITUTE AT COPENHAGEN.

The Technical Institute, at Copenhagen, was founded in 1843, by private zeal; its purpose is to give instruction in drawing as applied to various industrial branches. It is managed by an Executive Committee of five members, three of whom are appointed by the metal worker's society, of which the school forms a part, and two by the State. The general school manager appoints the teachers. The Committee publishes an annual report. There are about fifteen teachers.

It is open to all males who can read, write and spell decently, and perform a sum in the rule of three. Those who have not been confirmed form separate classes. This rite is performed at sixteen.

The instruction is, for the most part, given in the night, and comprises thirty classes in eight departments. These are as follows:

I. *Preparatory Drawing.*

A. Copying outlines; for two quarters; two classes, 6 hours weekly for young persons; two, 8 and 12 hours, for older persons.

B. Geometrical drawing on plane and rectangular projection; two quarters; two classes for the young, 6 hours, one for older persons, 8 hours.

Those passing through classes A. and B., or passing an examination in their subjects, may join the next class or any of the special classes.

BB. Preparatory to drawing ornaments, sketching from large plain outlines; two quarters; one class, 12 hours.

II. *Ornamental Drawing and Modeling.*

C. First ornamental for workmen wishing to cultivate a feeling for art Drawing from shaded copies of ornaments, and in outline from plaster casts; two quarters; one class, 12 hours. Pupils proceed, at option, to D or F.

D. 12 hours; 1. Perspective and sketching from solid geometrical figures and vessels with shading; 2. Perspective and ornamental. These lead into

E. Second ornamental. Shaded drawings from plaster ornaments, 12 hours; leads at option to elementary class of the Academy of Arts.

F. Clay modeling from drawings, models and natural objects, 12 hours. From this class pupils who have passed an examination in drawing from casts, in perspective and sketching from models, may join the Academy of Arts or class G.

G. Wax modeling, seven months, three hours.

III. *Architecture.*

H. Daily, from December 1 to March 31, from 9 to 2. 1. Day drawing class of geometrical projection and theory of shadows. 2. Preparatory for technical architectural drawing. Pupils must be able to draw in geometrical projection and attend the mathematical classes R (1) and (2) or be examined in their subjects. 3. Technical construction of buildings. Practical execution of parts of detail in buildings with calculation of dimensions and forces. Elementary mechanics, strength of materials, calculation of centre of gravity, with applications. Pupils must have passed H (2) or been examined, and also show competence in arithmetic and elementary geometry. They must further follow H (4) and (5) or be examined in their subjects. 4. Mathematics. Equations of the first and second order, logarithms, progressions. Pupils must understand elementary arithmetic and geometry. 5. Trigonometry, stereometry, and conic sections. Limitations as in the last, with necessity of knowing its subjects. 6. 8 hours. Evening drawing class for carpenters, masons, stone-cutters, &c.

IV. *Various Technical Drawing.*

- I. Joiners, turners, chair-makers, &c., 8 hours.  
 K (1) and (2). Smiths, mechanics, coach-makers, gun and instrument makers, ship-wrights, &c., two quarters, 6 hours.  
 L. Tin and copper-smiths, braziers, and gold-smiths, 8 hours.

V. *Technical, Metal Work.*

Practice, one evening a week, from October to May.  
 N. Turning; there are 12 lathes.  
 P. Engraving.  
 Q. Embossing and chiseling.  
 Metal-workers may follow the wax classes.

VI. *Mathematics. (Evening).*

R. Two quarters, three days weekly, 2 hours each. 1. Elementary arithmetic. 2. Elementary planimetry and stereometry, with applications.  
 For pupils wishing to join the architectural school of the Academy of Arts, the classes are preparatory for H (4) and (5). [See above].

VII. *Scientific Lectures.*

From December 1 to March 31, twice a week. Series 1. Principles of mechanical physics. 2. Theory of magnetism, and electricity.

VIII. *Supplementary for Drawing.*

From April 1 to June 30, two hours each evening. One upper and two lower classes.

In recent years, the average attendance has been about 500, of which about one-sixth are under sixteen, and almost all the rest workmen or apprentices, very few masters or overseers joining the school. In 1865-6, there were 618, of which 79 received free admissions, 19 entered the Academy of Fine Arts, and 15 passed the mathematical examinations of that institution. A mechanic and gold-smith were each presented with about \$100 (Danish) for traveling money.

The fees for instruction are as follows: In departments I and II about two dollars, three marks for the winter. In class G, however, two dollars for the winter. In classes H (1) (2) and (3) ten dollars for four months, five dollars in H (4) and (5). In H (6), I and K two dollars, three marks the quarter. In N, P and Q, for one evening, weekly, (two hours), one dollar per class, during the winter, two marks for each additional class. An apprentice, master, or other, pays half as much again. In R two dollars for three months.

The budget of the institution is about \$8,000, of which Government contributes about \$2,000 annually, \$2,800 come from fees paid by pupils, and \$1,100 from a fund called the "Reiersen Fund," part of which gives pecuniary assistance to workmen wishing to study their trades abroad. About \$240 are subscribed by tradesmen of the capital, the class for whose benefit the institution is directed.



## SPECIAL INSTRUCTION IN NORWAY.

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### INTRODUCTION.

THE kingdom of Norway, on an area of 123,386 English square miles, in 1865, had a population of 1,700,245.

Norway is essentially an agricultural and pastoral country. At the census of 1865, the inhabitants of towns numbered 272,531. A large number of the population are engaged in the lumber-trade, and next in importance to this are the fisheries, which give employment and support to the bulk of the population from the Naze to the White Sea. The commercial marine of Norway at the end of 1863 consisted of 6,109 vessels, of a collective tonnage of 578,722 tons, manned by 34,817 sailors. Considering its population, Norway has the largest commercial navy in the world. Norway, although dynastically united with Sweden, has an entirely separate constitution and government, her own ministry, her own parliament, her own army and navy, &c. The constitution of Norway, proclaimed Nov. 4, 1814, is one of the most democratic in Europe.

The annual expenditure in 1866 amounted to 25,728,000 francs, (\$5,145,600,) of which sum 1,050,787 francs were appropriated for educational purposes, whilst the total expense for public instruction was 4,005,812 francs. The system is administered by the Department of Church and Education, and includes :

-1. *Primary Schools.*—The rural communes are divided into 6,344 school districts; of these, 1,478 owned a house for the residence of the teacher, and the school-house, and 2,345 had no school-house or permanent teacher, but employed an itinerant schoolmaster. The number of children of an age to attend school was 212,136, of whom 206,622 actually attended school. The number of teachers was 3,118. Of higher primary schools there were 20, with 439 scholars. In the cities there were 116 elementary schools, with 42,892 scholars and 467 teachers, and 35 higher primary schools, with 159 teachers and 2,531 scholars. Besides these, there were 92 private higher primary schools, with 4,727 scholars. The number of infant schools was 27, with 2,876 pupils, and of Sunday-schools 20, with 1,526 pupils, thus making a total of 6,654 primary schools of all kinds, with 261,523 scholars and 3,744 teachers. The expenses for the rural elementary schools were 2,321,246 francs, whilst the income amounted to 2,219,654 francs. The expenses of the rural higher pri-

mary schools were 34,532 francs, of which sum the government paid 18,553. In the cities the expenses were the following: For elementary schools, 593,375 francs, of which the government paid 13,339; for the higher primary schools, 234,949 francs, of which the government paid 26,244; for infant schools and Sunday-schools the sum of 91,524 francs—making the total annual expenditure for primary education 3,275,626 francs, of which 58,136 were paid by the government, whilst the remainder was raised either by school-fees, income from property and funds, private contributions, &c.

2. *Secondary Schools.*—<sup>2</sup>These there were 16, 13 of which had a real-school connected with the school. The number of teachers was 197, and of scholars 2,105. The total expense was 593,570 francs, of which sum the government paid 184,889. The number of private secondary schools was three, with 1,161 scholars—making the total of secondary schools 19, with 3,266 scholars.

3. *Superior Schools.*—There is one university at Christiania, founded in 1811, with (in 1867) 36 ordinary professors, 6 ordinary professors, and 850 students. The total annual expense was 463,836 francs, of which sum the government paid 395,721. The university possesses a library of 150,000 volumes, a museum of natural history, a botanical garden, and an astronomical observatory.

4. *Special Schools.*—Besides the professional schools of Theology, Law, and Medicine, in the University at Christiania, there were:

5 Teachers' seminaries, with 286 students, (expense: 141,918 francs, of which sum the government pays 133,373.)

15 Smaller teachers' seminaries, (Normal courses or Institutes,) with 217 students, (expense: 26,657 francs, all paid by the government.)

1 Royal Norwegian school of drawing and arts at Christiania.

9 Provincial drawing-schools.

1 Technical school of construction at Horten.

1 Elementary school of mining at Kongsberg.

1 Model agricultural school near Trondhjem.

2 Institutions for the deaf and dumb at Christiania and Trondhjem.

1 Institution for the blind at Christiania.

5. *Supplementary Schools and Agencies.*—The work of elementary instruction in respect to orphans and infants, is aided by several asylums in the populous towns, and for girls by evening and other classes for instruction in needle-work.

6. *Societies for the Promotion of Science, &c.*—At Trondhjem there is a *Royal Norwegian Society of Science*; at Bergen, a *Museum of Art*, and at Christiania, a *Society of Norwegian Antiquities*, the *Royal Society for the Prosperity of Norway*, and other associations for special scientific purposes.



## SPECIAL AND TECHNICAL SCHOOLS.

A plan for a general system of technical instruction for Norway, reported by a special commissioner, M. Christie, in 1868, after visiting the technical schools of Sweden and Denmark, is now under the consideration of the Storting. Special schools of art, and particularly of drawing, have been in operation in the capital and provincial towns, and more recently several schools of agriculture and navigation have been established.

## THE ROYAL NORWEGIAN SCHOOL OF ARTS AND DESIGN.

According to the regulation of January 12th, 1841, this school is intended: 1, to further the education of mechanics by instruction in drawing, modeling, the elements of mathematics, &c., and to give to those who intend to become artists an opportunity of perfecting themselves in drawing; 2, to form, through its governing board, a society of arts, which is to spread an artistic taste throughout the country. This school gives also instruction in drawing to those students of the university who study mining and technics.

The course of instruction embraces drawing, mathematics, architecture, and according to circumstances, also modeling, mythology, and anatomy. Drawing has been taught in six classes, viz.: 1. The elementary class; pupils go through the first exercises for hand and eye partly after copies, partly after models of parts of the body by lamplight. 2. The class of free-hand drawing; pupils go through a complete course of free-hand drawing after copies, models of human figures, basso-relievo, vases, ornaments, &c., by lamplight. 3. The architecture class; pupils are first practiced in the drawing of constructions generally, and then in their application to architecture. 4. The ornament class; pupils are first instructed in the general drawing of constructions, then in their application to all sorts of work, with the exclusion of architecture and mechanics. 5. The machinery and mining class; pupils are instructed first in descriptive geometry and its application to the drawing of constructions after copies and after machines and models; secondly, in the drawing of mining-maps; thirdly, in the construction of timber-work and in surveying. 6. The higher artistic class; free-hand drawing is taught with special regard to a purely artistic education; pupils are instructed in drawing, after living models and plaster-casts.

The oral instruction comprises: 1. Geometrical drawing and perspective—4 hours a week; 2. Elements of geometry and stereometry—4 hours a week; 3. Theory of architecture—2 hours a week; 4. Lectures on mining; 5. Lectures on mythology and anatomy.

All instruction is gratuitous, the pupils only providing the necessary drawing material.

The only condition of admission is: the pupil must have completed the fourteenth year, and the preference is always given to mechanics. Pupils advance regularly from one class to the other, after having drawn some set object. The faculty consists of teachers and assistant-teachers, who are appointed by the Ministry of Public Instruction. There are also appointed a secretary, who is likewise treasurer and librarian, and a watchman.

The museum consists of a library and a collection of drawings and plaster-casts. The general superintendence of the school is in the hands of the Min-

istry of Public Instruction, which appoints a governing board consisting of teachers and at least three other members, who must be artists. This board makes an annual report to the Ministry.

The school has an annual subsidy from the State, amounting during the financial period 1866-69 to 3,200 Norwegian dollars. Besides this sum the city of Christiania makes an annual grant of 500 dollars. The annual appropriation for a national gallery is 1,500 dollars.

#### PROVINCIAL DRAWING-SCHOOLS.

The State grants assistance to various drawing-schools in provincial towns, on condition that the town contributes a sum equally large; that it provides a suitable room or rooms and submits the plan of instruction to the Ministry for its approbation. During the financial period 1866-69, the government grant to these schools amounted to 1,779 dollars, 60 shillings. At present the number of these schools is nine, located in the following towns: Drammen, Fredericks-hald, Skien, Christiansand, Stavanger, Bergen, Christiansund, Trondhjem, Tromsö.

#### THE TECHNICAL SCHOOL AT HORTEN.

This school, which is attached to the royal navy-yard, was opened in the year 1853, according to a plan drawn up by the navy department. This school is intended principally to give to those who wish to become practical mechanicians an opportunity of laying a theoretical foundation. Most of the pupils are men working in the navy-yard at Horten; but the school is likewise open to others, and it is intended to enlarge it considerably, so that all classes of mechanics may be admitted.

The course of instruction embraces: 1. Pure mathematics; arithmetic and algebra, including equations of the second degree and logarithms; geometry, elementary geometrical constructions, proportions, simple trigonometry. 2. Applied mathematics; elements of surveying, principles of equilibrium and motion, developed mathematically. 3. Physics; warmth with special regard to heating-apparatuses and steam-engines, elements of electricity of friction and its practical application. 4. Drawing; practical application of the sciences mentioned under No. 1; perspective and shading, drawing after models and machines. 5. English; intended to enable the pupil to read and understand English technical works. 6. Theory of machines, as far as time allows. 7. Chemistry (since 1860.)

The school is divided into two classes, one for beginners and one for more advanced scholars. The whole course may be gone through in two years. Instruction is imparted gratuitously, and pupils have only to furnish their own drawing material.

The conditions for admission are: Pupils are admitted every year at the end of August; candidates for admission must be confirmed, must be able to read fluently, to write legibly or orthographically, and know arithmetic as far as the rule of three. Since 1857 the school possesses a building where 30 scholars can be accommodated; hitherto the number has rarely exceeded 20, and will scarcely exceed that number, unless the number of teachers is considerably increased.

Every half-year an oral and written examination takes place. On leaving



the school, pupils receive a certificate showing how far they have been successful or not. The directing board must make an annual report to the navy department.

The teachers are appointed by the navy department, and number at present 6, viz.: 1 of mathematics, physics, chemistry; 1 of drawing; 1 of machine-drawing; 1 of English, and 1 assistant-teacher, who is taken from among the older pupils of the school.

The school possesses a library and physical and chemical apparatus.

The navy department has the general superintendence; the governing board consists of the director of the Horten navy-yard, one of the teachers, and another man of science appointed by the navy department.

In 1866 the Storting appropriated the annual sum of 300 dollars for an examination to be held annually at Horten, where any machinist in the country may obtain a certificate of ability.

It deserves to be mentioned, in speaking of this school, that the navy-yard at Horten takes pupils for working in the navy-yard and for drawing. These are of two kinds: 1. Technical pupils, to a number not exceeding ten, who must pledge themselves to remain at the navy-yard for five years. The first two years they receive no salary. 2. Working pupils, mostly children of workmen; they receive a small daily salary.

#### SCHOOL OF MINES AT KONGSBERG.

The school connected with the silver mines at Kongsberg, opened in 1867, is intended to give free elementary instruction in certain special branches useful in mining pursuits. The number of the pupils is limited to eight, the qualifications being that they shall be over eighteen, and shall have proved themselves able miners there or in some other place. They must be able to read and write, and must be acquainted with the first four rules of arithmetic.

Instruction is given in the elements of mineralogy, geology, mechanics, and physics; in mathematics, elementary arithmetic, geometry, trigonometry, stereometry, geometrical drawing, and land and mining surveying, with practical exercises in the mines. The course covers two or three years, with two days' instruction per week.

The pupils provide themselves with writing and drawing materials. They work in the mines and receive pay for the same.

Examinations are held at the end of the course in the presence of at least one member of the board of mines; at this examination the drawings of the pupils are likewise exhibited. After having satisfactorily finished the course, pupils receive a certificate of ability.

The superintendence of this school is intrusted to the Kongsberg board of mines, which appoints the teachers and manages the affairs of the school. The government has granted an annual subsidy of 300 dollars.

#### SCHOOL ATTENDANCE AND FACTORY SCHOOLS.

The new school law of 1860 makes it obligatory on parents and guardians of children to secure their attendance at school from the completion of their eighth year till their confirmation, or until they have attained their 14th or 15th year, on the penalty of a fine or even imprisonment for each absence unaccounted for. The owners of all industrial establishments must see that children within

the school age attend school for at least sixteen weeks in the year, in the school of the district, or in a special school. Any child, who has attained the age of 14, who is deficient in the knowledge of the elementary school, must receive separate instruction up to that point, the expense of which must be refunded by the parent or guardian.

PLAN FOR A COMPLETE SYSTEM OF TECHNICAL INSTRUCTION IN NORWAY.

Mr. H. Christie of Christiania, after having by order of the Norwegian government visited the technical institutions of Sweden and Denmark during the summer of 1867, submitted the following plan for a system of technical instruction in Norway to the Storting. He recommends the establishment of the following institutions:

1. *Technical Sunday and evening schools*, intended for the further technical education of mechanics. Such schools should be founded wherever a town is willing to grant a certain annual sum for this purpose.

2. *Technical elementary school* at Bergen and Trondhjem, intended to provide young men who wish to follow technical pursuits with the necessary elementary knowledge. The course of studies is to embrace mathematics, mechanics, mechanical technology, drawing, physics, chemistry, modeling, Norwegian, German, English, book-keeping, gymnastics, singing. The instruction is to be more of a practical than a purely theoretical character. The course is to cover three years and the school is to have three classes. Such schools would each require 8 teachers, and the number of rooms should not be less than 19; a laboratory, physical cabinet and library ought to be attached to each school.

3. *A Polytechnic Institute at Christiania*.—This establishment should be on the general plan of similar institutions in other European countries. The aim would be to become a higher educational establishment for young men who wish to study the technical sciences. As a general rule the instruction is to be of a practical more than of a theoretical character. The course of instruction is to embrace mathematics, mechanics and theory of machinery, mechanical technology and construction of machinery, general architecture, construction of roads, bridges and canals, surveying, chemistry and chemical technology, physics, (general and applied,) mineralogy and geology, drawing, and descriptive geometry. The course is to cover three years. Instruction is to be imparted gratis, with the exception of a small fee for the use of the chemical laboratory. In order to be admitted, a candidate would have to pass a satisfactory examination in elementary mathematics and all those subjects which are generally taught at school; the age must be no less than 16 years. The school is to consist of a one year's preparatory school for all the students, and three parallel schools, each of two years, viz., a school of civil engineering, a school for machine-construction, a chemical school. The average number of instruction hours should be 32 per week, throughout the whole of the three years' course. At the end of every year, class and final examinations are to be held, and after having satisfactorily absolved the last-mentioned one, the student receives a certificate as "technical candidate." The institution would require 8 teachers and 5 assistants, the number of rooms could not well be less than from 20 to 23, and the estimated annual expense would be 8,200 dollars, (Norwegian.)



## SPECIAL INSTRUCTION IN SWEDEN.

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### INTRODUCTION.

THE kingdom of Sweden, on an area of 168,042 English square miles, on Jan. 1, 1866 had a population of 4,114,141.

Four-fifths of the population of Sweden are devoted to agricultural pursuits, but only a very small fraction of the rural population are owners of the land which they are cultivating. Mining is the most important department of Swedish industry, and the working of iron mines in particular is making constant progress by the introduction of new machinery. It is only within recent years that Sweden has become a manufacturing country.

The annual expenses are 31,250,000 rix-dollars (1 rix-dollar=54 cents,) of which sum 4,032,000 are applied for educational purposes. Public instruction is administered by the Minister of Education and Ecclesiastical Affairs, and embraces :

1. *Primary Schools*.—There were 5,497 schools of this grade in 1866, with 368,129 children on the books, and 192,231 present at the inspection.

2. *Secondary Schools*.—Instead of the former gymnasia, there are so-called "higher elementary schools," *i. e.* gymnasia and real-schools combined. In 1859 there were the following: 23 complete schools of 7 or 8 classes, with 335 teachers and 4,829 scholars; 7 real-schools and 3 schools for classical education, with 56 teachers and 836 scholars; 12 schools, with 72 teachers and 1,359 scholars; 11 schools of 3 to 5 classes, with 34 teachers and 461 scholars; 16 schools of 2 classes, with 32 teachers and 600 scholars; 31 *pedagogien*, (between the superior and the elementary schools,) with 41 teachers and 1,169 scholars—making 103 secondary schools, with 570 teachers and 9,254 scholars.

3. *Superior Schools*.—There are in Sweden two universities, one at Upsala with 29 ordinary professors, 20 assistant professors, and 33 private professors, (*privat docenten*,) and 939 students. There is a library of 160,000 volumes and 8,000 manuscripts, a large collection of coins, a magnificent mineralogical and botanical museum, and a zoölogical museum, a botanical garden and an astronomical observatory. The other university is at Lund, with 21 ordinary professors, 15 assistant professors, and 24 private professors, (*privat docenten*,) and 360 students. There is a library of 100,000 volumes and several thousand manuscripts, a zoölogical museum, an anatomical museum, a historical and archæological museum, a chemical laboratory, a botanical garden, and an astronomical observatory.

4. *Special Schools*.—1 Technological Institute in Stockholm; 2 Mining Schools at Falun and Filipstad; 1 Technical School at Gothenburg, 107 scholars; 4 Elementary Technical Schools: at Malmi, Oerebro, Norrköping, Boräs; 1 Technical Sunday and Evening School at Eskilstuna; 1 School of Ship-building at Carlsrona; 9 Navigation Schools; 5 Teachers' Seminaries; 1 Military Academy at Marieberg; 1 Artillery School at Carlsberg; 6 Military Schools; 1 School of Surgery at Stockholm; 1 Forest Academy; 2 Institutes for Deaf and Dumb; 1 Institute for the Blind.

## GENERAL AND SPECIAL TECHNICAL SCHOOLS.

The technical schools of Sweden are divided into general and special. Those giving general industrial instruction are :—

1. *Sunday and evening schools*, for workmen ; such exist at Eskilstuna, Norköping, Malmö, Orëbro, and Boräs, containing together 634 pupils. These are preparatory for the

2. *Elementary technical schools*, for foremen ; of these are five, one in each of the above towns, with 192 pupils.

Combining the characteristics of this and of the last class are the Industrial School at Stockholm, and the School of the Industrial Society at Gothenburg, with 1,646 pupils. These are preparatory for the next class.

3. *High technical Institutes* ; the Technological Institute or Polytechnic School at Stockholm, founded in 1825, and the parallel establishment, Chalmers' Industrial School at Gothenburg, instituted in 1829, containing together 207 pupils.

To the class giving instruction in special industries belong—

1. The Elementary Mining School at Filipstad, and the Mining School at Fahlun, with 40 pupils together.

2. The ship-building institution at Carlserona ; 25 pupils.

3. Navigation schools, of which there are nine, with an aggregate attendance of about 180 pupils.

Although these schools are so arranged that those giving general instruction are in series, yet the course in each is complete and independent. They are open to all persons connected with industries, and with some few exceptions, the instruction is gratuitous. In these cases, the poor are exempted from payment.

Instruction is given by lectures, illustrated by drawings, models and specimens, examinations, working of problems, and practical work.

The teachers are appointed by the respective corps of directors, with certain exceptions referred to in the individual cases. They must possess a certain knowledge of their specialties and ability to teach them, these qualifications being proved by certificates, and by public proof in the schools. Generally they have studied at the University or at one of the higher technical schools, and have subsequently obtained practical experience.

There are no special privileges attached to graduates, except to those from the mining schools, who are promoted to vacancies in the Government Mining Bureau.



## SUNDAY AND EVENING SCHOOL AT ESKILSTUNA.

The Eskilstuna school, which we take as an example of its class, gives instruction chiefly adapted for working mechanics; it receives pupils over twelve years of age who can read and write, and who have some religious knowledge. The superintendent, who is head-master, is appointed by the Board of Commerce.

The studies are arithmetic, geometry, geometrical and free-hand drawing, mechanics, physics, chemistry, modeling, book-keeping, and orthography. The scientific studies pursued in this class of schools, with special reference to the industries of the locality, are, in Eskilstuna, directed to the encouragement of the iron and steel manufactories of the town. The term varies in length, but must extend over one year at least, in order to secure a certificate of examination. This institution receives from the government 5,000 rigs-dollars annually, and is the only one of its class not supported by the communes.

## ELEMENTARY TECHNICAL SCHOOL AT NORKÖPING.

The elementary technical school at Norköping gives the necessary theoretical instruction to those wishing to be foremen, admitting pupils above fourteen, able to read and write, and acquainted with the elementary grammar of the Swedish and German or English, history and geography, especially of Sweden, arithmetic, through decimals and elementary geometry.

The branches taught, during the course of three years, are as follows:—1. Mathematics, comprehending arithmetic, elementary geometry, algebra, with the theory of logarithms and series, and of plane trigonometry. 2. Geometrical drawing, in plane and in elevation, and perspective drawings of tools, machines, buildings, &c., chiefly from models. 3. Free-hand drawing, chiefly of ornaments, utensils, and other objects applicable in industries, mechanical trades, and architecture; modeling in clay and wax of such ornaments, figures, &c., as are adapted to develop taste and artistic skill in the practice of particular industries. 4. Mechanics, both theoretical and applied to machinery, &c., connected with manufactures, agriculture, and other industries, comprehending also the elements of architecture and mechanical technology, with a knowledge of the most important raw materials connected therewith, and manufactured products of such raw materials in different stages of completion. 5. Experimental practice in the laboratory of the school. 6. Physics, both general and applied to industries, elucidated by experiments. 7. Chemistry, general and applied to industries, elucidated by experiments and materials, and by practical experiments in the laboratory of the school. 8. Botany and zoölogy, with reference particularly to plants and animals useful in a technical point of view, together with such parts of the same as occur in commerce and industry. 9. Languages. 10. Book-keeping.

For this school (as for others of its class) the building and school premises are at the charge of the commune, while teachers' salaries, the cost of instruments, and other necessary expenses, are met by the State, the annual grant being 12,000 rigs-dollars. There is an entrance-fee of from four to ten rigs-dollars.

## INDUSTRIAL SCHOOLS AT STOCKHOLM AND GOTHENBURG.

The two industrial schools at Stockholm and Gothenburg are peculiar as uniting the characters of the elementary and the Sunday and evening schools, and require the same previous preparation, the former however receiving pupils at

thirteen. That at Stockholm has also a course for female pupils, given at hours separate from those of the others. The superintendents are appointed by the crown. The terms vary in length, but must be at least one year long to secure a certificate of examination.

The Stockholm institution has a new building, erected with the aid of grants from the State and from the city, and is supported by an annual grant from the former of 79,000 rigs-dollars, together with contributions from the city and the Swedish Industrial Society, and bequests from private individuals. There is an entrance-fee of four to ten rigs-dollars, and a term-fee of eighteen rigs-dollars and seventy-five oere. It has (1866) 1,346 pupils, of which 856 are male.

That at Gothenburg, founded by the Polytechnic Union, is maintained by the commune and by private contributions. It numbers (1866) 300 pupils. The course of instruction is more limited than at Stockholm, owing to want of resources.

#### MINING SCHOOLS AT FILIPSTAD AND FAHLUN.

The mining schools at Filipstad and Fahlun have for their object the training of skilled mining mechanics and engineers and managers of iron-works. They are open to pupils above the age of eighteen who have passed the mining examination at the university or are prepared in the following branches: religion, history and geography, especially of Sweden, arithmetic, six books of Euclid, stereometry, algebra as far as equations of the second degree, the first elements of plane trigonometry and the use of logarithms, with physics, chemistry, and mechanics. They must be able to write plain and tolerably correct Swedish compositions, and to translate easy German authors with facility. These are the same qualifications as are demanded for the Polytechnic, except that physics, chemistry and mechanics are carried farther than for that school.

The curriculum of the school at Fahlun comprises analytical chemistry, mineralogy, surveying of mines, the art of smelting, practical geometry and metallurgy; mechanics, especially the theory of mining machines; geology, mining, comprising the study of the manner in which useful minerals occur and of their discovery; and of the opening and measurement of mines; besides which the pupils spend a certain time, under the superintendence of the teacher, in practical operations at iron-works and mines, and also in traveling to different parts of the country, in order to inspect such works, plans being drawn of the mines surveyed during these journeys.

At Filipstad, the studies are theoretical and practical geometry, plane trigonometry, physics, mechanics, geometrical drawing, leveling, chemistry, geology, mineralogy, and the metallurgy of iron, with practical studies of iron-working in mines, foundries, or iron-works.

The superintendent and second master of the Fahlun school is appointed by the king; the superintendent of that at Filipstad, by the delegates to the iron office. The latter is also head-master. The Fahlun establishment has (1866) 25 pupils, and is free, being supported partly by the Association of Iron-masters, and partly by the State, which gives it an annual grant of 9,700 rigs-dollars. It is intended to consolidate it with the Polytechnic School. The Filipstad institution has 20 pupils (1866,) paying 50 rigs-dollars per annum. It is supported by the Association of Iron-masters.

None but graduates of these establishments can fill the post of clerks and stipendiaries at the iron office.



## THE POLYTECHNIC SCHOOL AT STOCKHOLM.

The Technological Institution (*Slögdskolan*) or Polytechnic School at Stockholm, (an entirely distinct institution from the industrial school at the same place, sometimes referred to as a polytechnic school,) has for its object to impart the highest grade of scientific and technical instruction.

There are three sections; one of machine construction and mechanical technology; one of chemical technology; one of civil engineering. The contemplated union with it of the Mining School at Fahlun will add a fourth, with three subdivisions; of mining mechanics, of foundry, and of mining engineering.

It is open to boys at sixteen who possess the following qualifications: a fair degree of religious instruction, history, and geography, especially of Sweden; arithmetic, six books of Euclid, stereometry, algebra as far as equations of the second degree, the first elements of plane trigonometry and the use of logarithms, with physics, chemistry, and mechanics. He must be able to write a plain and tolerably correct Swedish composition, and to translate easy German authors with facility.

The superintendent, who is not obliged to instruct, and the professors, fifteen in number, are appointed by the king. The course of instruction covers three years, and consists of—1. Pure mathematics, comprising principally analytical geometry, the elements of the theory of equations, and differential and integral arithmetic. 2. Practical geometry, comprising surveying and leveling for engineering and other technical purposes. 3. Descriptive geometry, both general and applied to structures of stone and wood, and to perspective and shading. 4. Theoretical mechanics, or the theory of the equilibrium and motion of bodies, in which are also comprised the theories for the construction of arches, the pressure of loose masses of earth, and of iron and wooden structures connected with the erection of edifices. 5. Applied mechanics, comprising the knowledge of machinery intended to gather and communicate natural motive-power, or otherwise adapted for general application. 6. Mechanical technology, comprising a knowledge of the arts of producing those manufactures, the production of which solely or chiefly depends on mechanical appliances; and also including an acquaintance with the raw material employed, and the qualities of the manufactures produced. 7. General physics. 8. Applied physics, with reference more especially to the technical application of heat, light, electricity, and magnetism. 9. General chemistry. 10. Chemical technology, comprehending a knowledge of the manner in which those manufactures are produced which are chiefly dependent on chemical agency; and also an acquaintance with the raw materials employed, and the qualities of the manufactures when completed. 11. Mineralogy and geognosy, so far as these sciences possess a practical application. 12. General architecture, and the construction of houses. 13. Civil engineering. 14. Drawing, viz., geometrical and free-hand drawing and touching with Indian ink. 15. Modeling ornaments and bas-reliefs. In addition to the above, instruction is given, in the workshops of the schools, in the use of tools, and machines employed in working metals and wood.

Instruction is given in the following manner:—1. Lectures delivered by the teachers, in which the subject, when requisite, is elucidated by models, drawings, samples, and experiments. 2. Repetitions, by means of questions addressed to the pupils, and by the solution of problems given to them to perform.

3. The execution of drawings (with descriptions) of machines, apparatus, edifices, and other objects on which instruction is given, and also of plans of industrial establishments, all under the guidance and superintendence of those teachers whose subjects of instruction comprise the works or establishments delineated. 4. Practical exercises, under the superintendence and guidance of the respective masters in surveying and leveling, in practical mechanics, general chemistry, chemical technology, the art of drawing, and the working of metals and wood.

The number of pupils (1866) is 100. It is maintained by the State, the present annual expenditure being about 55,500 rix-dollars.

#### CHALMERS' INDUSTRIAL SCHOOL AT GOTHENBURG.

Chalmers' Industrial School is adapted for those persons intending to pursue high technical professions. The superintendents are appointed by the king. Pupils are admitted at fourteen. The requirements for admission, the curriculum, and the mode of instruction, correspond with those of the Polytechnic School at Stockholm. One branch, not taught at the Polytechnic School, but here entered upon, is the modeling of free-standing figures in wax, clay, and gypsum. There are (1866) 107 pupils. The institution was founded and derives its chief support from a private bequest, but enjoys a State grant also of 21,500 rix-dollars.

#### SCHOOL OF NAVAL ARCHITECTURE AT CARLSCRONA.

The purpose of the School of Naval Architecture at Carlscrona is to train competent workmen and foremen for the ship-building yards. Candidates must be fourteen years of age, possess a fair degree of religious knowledge, an elementary knowledge of Swedish and English grammar, history and geography, especially with regard to Sweden; arithmetic as far as the rule of three, and elementary geometry.

The subjects of instruction are mathematics, including planimetry, stereometry, algebra, plane trigonometry, the theory of conic lines, mechanics, hydro-mechanics, descriptive geometry, differential and integral calculations; ship-drawing and the construction of mercantile vessels; theoretical and practical ship-building, mast-building, the study of the materials employed in ship-building; the gauging of ships; the art of constructing steam-engines; geometrical drawing; free-hand drawing; English; practical work in ship-building, each pupil being obliged to work at least one hundred days annually in the ship-yards, for which he receives daily pay.

The number of pupils is (1866) about 25. The school is supported by a State grant of 7,000 rix-dollars per annum.

#### EVENING SCHOOLS OF ART.

Mr. Brace, in his "Visit to the Homes of Norway and Sweden," describes the "Evening School of Art" in Stockholm, established by Prof. Siljeström, thus:

All this, with beautiful plaster models of Greek sculpture, bas-reliefs of Italian statuary, the orders and ornaments of architecture, with lessons and teachers, lectures on chemistry and other sciences, is open every evening for the laboring men and women. All are made artistic artisans, and women are provided with a new and beautiful means of living. Such schools exist all over Sweden. Except the Schools of Design for Women in Boston and New York, I know of nothing of the kind in the United States.



## SPECIAL INSTRUCTION IN RUSSIA.

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### INTRODUCTION.

RUSSIA in Europe has an area of 1,992,574 English square miles, exclusive of Finland (140,800 English square miles) and Poland (51,040 English square miles.) Russia in Asia has an area of 5,428,460 English square miles. The area of the whole Russian empire is therefore 7,612,874 English square miles.

The population of Russia in Europe was, according to the census of 1864: 61,061,801; of Finland, 1,798,909; and of Poland, 5,336,210; of Russia in Asia (Siberia and Transcaucasia,) 8,074,704—thus making the population of the whole Russian empire 76,271,624.

The government is an absolute hereditary monarchy, the whole legislative, executive, and judicial power centering in the emperor, whose will alone is law, although exerted through councils and ministers of his appointment.

The majority of the population are engaged in agriculture; a considerable foreign commerce is carried on, employing near 2,000 vessels of Russian construction; and more than 500,000 hands are employed in manufacturing establishments.

The general superintendence of all the educational establishments of the empire is intrusted to the Ministry of Public Instruction, although even more extensively than in other countries there are special schools not only for the public service, but of particular classes, which are under the superintendence of other Ministries. The Ministry of Public Instruction is composed of the minister, several counselors, a commission on elementary and one on higher education, and a publication committee. In the estimated expenditure for 1869 this Ministry is credited for ordinary service with 9,281,220 rubles.

The educational system, as revised in recent codes, comprises primary, secondary, superior, and special schools, of which we gather the following statistics from recent authorized statements.

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\* For history and details of the present organization, see Special Report on National Education—*Russia*.

## STATISTICS OF PUBLIC INSTRUCTION IN RUSSIA.

### I. PRIMARY SCHOOLS.

In Russia in Europe there were, in 1865: 1,760 public elementary schools, with 78,999 scholars. The number of private elementary schools under government inspection was 799, with 22,814 scholars. Under the superintendence of the Ministry of Imperial Domains there were 7,137 schools, with 226,996 scholars. The Ministry of the "Apanages" had 294 village schools, 1,046 parochial and private schools, 721 private borough-schools, and 111 schools in connection with the Mohammedan mosques. The ecclesiastical authorities of the Orthodox Greek Church have 8,587 elementary schools, with 320,350 scholars. The number of public elementary schools in Siberia was 86, with 2,494 scholars. In Poland the number of public elementary schools (in 1861) was 1,381, with 80,378 scholars. In Caucasia there were (in 1856) 74 schools, with 5,505 scholars. In Finland there were 14 upper and 57 higher elementary public schools, with about 9,000 scholars.

The number of district-schools (burgher-schools) in Russia in Europe (exclusive of Finland and Poland) and Siberia was (in 1865) 416, with 23,952 scholars and 2,743 teachers; and in Poland, 195 district schools.

The grand total is 61,000 elementary schools, exclusive of schools of the same grade specified below, with 1,500,000 pupils.

### II. SECONDARY SCHOOLS.

In Russia in Europe (exclusive of Poland and Finland) there were, in 1865: 101 gymnasia, with 26,789 scholars and 2,312 teachers. In Finland there were 6 gymnasia; and in Poland 7 gymnasia, with 122 teachers and 2,172 scholars; and 17 philological schools, with 169 teachers and 2,856 scholars—making a total of 500 institutions of secondary instruction, with 100,000 pupils.

### III. SUPERIOR INSTRUCTION.

There are in Russia in Europe, 6 universities (St. Petersburg, Moscow, Khar-kow, Kasan, Dorpat, Kiew, Odessa,) with 5,314 students and 455 professors. In Finland there is one university at Helsingfors. Besides the university professorships, there are special theological seminaries belonging to the several religious bodies, and lyceums at Jaroslawl and at Njeschin, both preparatory for the civil service.

### IV. SPECIAL AND PROFESSIONAL SCHOOLS.

6 Teachers' seminaries (at St. Petersburg, Dorpat, Kiew, Kharkow, Molodatschno, and Wilna); 3 schools with a pedagogical course; and a special course for gymnasium teachers.

The following special institutions are under special ministries:

#### A. RUSSIA.

*I. Institutions for Daughters of Nobles, Military Officers and Officials, under the immediate protection of the Imperial Family.*

1 Smalnoa training establishment at St. Petersburg,	83 teachers,	392 scholars.
1 School of Order of St. Catherine at St. Petersburg,	56 " "	357 " "
1 " " " " " Moscow,.....	59 " "	288 " "
1 Patriotic institute for girls, . . . . .	36 " "	244 " "
12 Other institutes for noble young ladies,.....	356 " "	1,589 " "
13 Second-class establishments,.....	426 " "	1,533 " "
12 Third-class establishments for girls of lower rank,	207 " "	953 " "

#### *Establishments for Special Classes.*

1 Nicholas orphan institute at St. Petersburg,.....	166 teachers,	793 scholars.
1 Nicholas orphan institute at Moscow, . . . . .	108 " "	725 " "
1 Deaf and dumb school at St. Petersburg,.....	23 " "	65 " "
1 School of midwifery at St. Petersburg,.....	14 " "	131 " "
1 School of midwifery at Moscow,.....	16 " "	82 " "
1 Foundling hospital at Moscow, . . . . .	40 " "	125 " "
5 Public gymnasia for young ladies.		



SPECIAL INSTRUCTION IN RUSSIA.

The following institutions are for males :

1 Alexander lyceum at St. Petersburg, . . . . .	33 teachers, 126 scholars.
1 Deaf and dumb school at St. Petersburg, . . . . .	13 " 101 "
1 Commercial school " " . . . . .	35 " 299 "
2 Hospital-assistants' schools " " . . . . .	11 " 85 "
1 Nicholas orphans' institute at Gatchina, . . . . .	44 " 671 "
1 Section of the foundling hospital at Moscow, . . . . .	21 " 96 "
1 Commercial school at Moscow, . . . . .	24 " 121 "
1 Hospital-assistants' school at Moscow, . . . . .	15 " 251 "
1 Mechanics' institute " " . . . . .	18 " 290 "
1 School for masters for instructing in trade-schools, . . . . .	14 " "

*II. Special Schools under the Ministry of War.*

1 Medico-chirurgical academy, . . . . .	35 teachers, 978 scholars.
5 Surgeon-barbers' schools at the different military hospitals, . . . . .	17 " 1,020 "
1 Topographers' school, . . . . .	13 " 140 "
22 Military schools, . . . . .	10,000 "
3 Artillery schools, . . . . .	22 " 166 "
1 Nicholas staff-academy, . . . . .	22 " 250 "
1 Nicholas higher engineer-school, . . . . .	50 " 126 "
1 Michael artillery school, . . . . .	32 " 117 "
1 Page-corps or college, . . . . .	41 " 159 "
1 Ensigns' school of the guards, . . . . .	31 " 206 "
22 Cadet corps, or military colleges for the guards and line, . . . . .	723 " 7,440 "

*III. Naval Schools under the Ministry of Marine.*

1 Naval cadet-college, . . . . .	92 teachers, 631 scholars.
1 Practical naval school for seamen, . . . . .	15 " 553 "
1 Commercial navigation school at Cronstadt, . . . . .	12 " 45 "
1 Pilots' school at Cronstadt, . . . . .	32 " 355 "
1 Lower engineer and artillery school at St. Petersburg, . . . . .	38 " 265 "
1 Black Sea pilots' school at Nicholaieff, . . . . .	18 " 415 "
1 Naval school " " . . . . .	18 " 415 "
1 Girls' institute " " . . . . .	7 " 100 "

*IV. Schools under the Ministry of the Interior.*

19 Orphan houses, . . . . .	754 pupils.
6 Foundling hospitals, . . . . .	2,410 "
19 Schools for the children of chancery servants, . . . . .	953 "
3 Hospital-assistants' schools, . . . . .	199 "
1 School for hospital-servants' children, . . . . .	42 "

*V. Schools under the Ministry of Finance.*

1 Mining institute, . . . . .	37 teachers, 242 scholars.
1 Mining technical school, . . . . .	36 " 21 "
1 Assaying school at St. Petersburg, . . . . .	8 " 14 "
7 District foundry schools, . . . . .	41 " 361 "
44 Lower foundry schools for the mint and mining, . . . . .	131 " 3,957 "
1 Technological institute, . . . . .	36 " 257 "
Sunday drawing-school connected with it, . . . . .	3 " 72 "
1 Drawing-school at St. Petersburg, . . . . .	11 " 646 "
1 Female division of the same, . . . . .	7 " 215 "
3 Drawing-schools at Moscow, . . . . .	24 " 667 "
Sundry primary schools for children employed in factory labor, . . . . .	
Sundry private manufactory schools, . . . . .	12 teachers, 478 "
1 Practical commercial academy at Moscow, . . . . .	30 " 174 "
1 School of commercial navigation at Cherson, . . . . .	9 " 48 "
1 " " " " " Riga, . . . . .	1 " 10 "
1 School for masters of merchantmen at Archangel, . . . . .	1 " 12 "
1 " " " " " Remi, . . . . .	1 " 9 "

SPECIAL INSTRUCTION IN RUSSIA.

*VI. Schools under the Ministry of Public Works.*

1 Institute of the roads' engineer corps, . . . . .	50	teachers,		270		scholars.
1 Master-builders' school, . . . . .	32		"	164		"
1 Signal and telegraph school.						

*VII. Schools under the Ministry of Justice.*

1 School of jurisprudence, . . . . .	43	teachers,		231		scholars.
1 Preparatory class for the above school, . . . . .	20		"	167		"
1 Constantine surveyors' school, . . . . .	36		"	250		"
1 Writing school for copyists in government offices, . . . . .	7		"	60		"
1 Surveying topographers' school, . . . . .	23		"	200		"

*VIII. Schools under the Ministry of the Imperial Domains.*

1 Forest-academy at St. Petersburg, . . . . .						
1 Course of forestry at Lissina, . . . . .						}
2 Schools for huntsmen, . . . . .						
2 Schools for game-keepers, . . . . .						599 scholars.
1 Academy of agriculture at Gorygoretsk, . . . . .						}
1 Academy of agriculture near Moscow, . . . . .						
1 Academy of horticulture.						857 scholars.
18 Agricultural and horticultural schools.						

*IX. Schools under the Ministry of Foreign Affairs.*

Institute of Oriental Languages at St. Petersburg.  
Lazareff Institute, for do. at Moscow.

*X. Academies, Museums and Agencies of Art, Science, &c.*

Academy of the Fine Arts at St. Petersburg.  
Hermitage Gallery and Museum.  
Taurida Palace Museum of Sculpture.  
Roumiantstoff Museum.  
Academy of Sciences.  
Imperial Library at St. Petersburg (900,000 volumes.)  
Yablonoff Cabinet of Art Curiosities.  
Observatory at Poolkova.  
Botanical Garden.  
Museum of Russian Antiquities.  
Museum of Technological Institute.  
Museum of Rural Economy.  
Museum of Mines and Metallurgy.  
Museum of Natural History.

The above list includes only the most prominent institutions of this class.

B. POLAND.

- 1 Medico-chirurgical academy.
- 1 Nobility institute.
- 1 Government Ladies' boarding-school.
- 1 School of arts.
- 2 Technological high-schools.
- 1 School of agriculture and forestry.
- 1 Sunday commercial school.
- 1 Normal school for primary teachers.

C. FINLAND

- 1 Cadet corps at Friedrichshamm.
- 3 Navigation schools.
- 3 Technological schools.
- 3 Commercial schools.
- 1 Institute for rural economy at Mustiala.
- 10 Agricultural schools.
- 6 Girls' schools (industrial.)



# SPECIAL SCHOOLS OF SCIENCE AND THE ARTS

IN RUSSIA.

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THE Special Schools of Science, as applied to the great industries of the Empire, and the service of the government, have been liberally endowed, and many of them have attained a high degree of development.

## POLYTECHNIC SCHOOL AT ST. PETERSBURG.

The Polytechnic Institute at St. Petersburg was founded in 1829; some of the students live at the institute and pay 15 rubles per month for their board, &c.; others live in town and pay an annual school-fee of 30 rubles; with an addition of 40 rubles, if they take any part in the practical exercises in the workshops or laboratories connected with the Institute. The conditions of admission are: Sacred history, history of the Christian Church, Russian language and literature, general and Russian history, geography, elements of physics, mathematics, and algebra, up to equations of the second degree; geometry, trigonometry, French and German. The whole organization of the Institute is very similar to that of the higher technical schools of Germany. For practical instruction there are in connection with the Institute a chemical laboratory, workshops for turners, carpenters, and engravers; besides these, there are a forge, dyery, foundry, and a steam-engine. The course in both sections, the chemical and mechanical, has been fixed at 4 years; and on leaving the Institute the students receive the degree of technologist of the 1st and 2d class. We give below in detail the course of instruction at the Polytechnic Institute for the first and fourth year, the second and third being an extension of the first:

### FIRST YEAR.

*Theology*, (1 recitation per week.)—Detailed Commentaries on the Articles of Faith, on the mysteries of the resurrection and eternal life; The leading idea of the Christian's hope and the Christian's prayer; The union of love, faith, and the Ten Commandments; Lectures on the Catechism, showing in what manner one ought to profit by the teachings of religion and piety.

*Chemistry*, (inorganic,) (4 recitations per week.)—The phenomena of contact, and the mutual influence of substances on each other; The properties and combinations of metalloids; Metals, their properties, their natural state; Extraction and preparation of these substances; Chemical combinations.

*Physics*, (2 recitations per week.)—Law of statics; Simple machines; Mechanics; Attractive power; Centre of gravity; Mathematical pendulum; Hydrostatics; Principle of Archimedes; Density and volume; Laws of capillary tubes; Equilibrium of gases; Barometer; Application of Mariotte's law; Sound.

*Higher Analysis*, (5 recitations per week.)—Analytical geometry; Solution of geometrical problems by means of algebra; Properties of curves; Surfaces of the second order; Differential and integral calculus.

*Higher Algebra.*—Application of algebra to imaginary quantities; Solution of equations of the higher degrees; Reduction of rational fractions.

*Elementary Statics*, (2 recitations per week.)—Construction and reduction of forces; Conditions of equilibrium; Simple machines.

*Descriptive Geometry*, (1 recitation per week.)—Method of projections; Projections of points, straight lines, curves, even surfaces, and curved surfaces; Various problems, (done by the aid of ruler and compasses.)

*Architecture and Land Surveying*, (2 recitations per week.)—General principles; Study of the surface of the earth; Sounding; Preparation of materials of construction; Construction of embankments; Ventilation, &c.; Draining of swamps; Draining and irrigation; Surveying operations; Description of instruments used in these operations, the way of using them and examining them.

*Metallurgy and Mining*, (2 recitations per week.)—Short geological description of the globe; Layers, metallic veins; Way of extracting metals; Works with gunpowder under water; Making of tunnels, aqueducts; Wells; Various systems of natural and artificial ventilation; Rollers, capstans, machines for draining water from mines; Signals.

*German*, (2 recitations per week.)—Analysis of the best works of German literature.

*French*, (2 recitations per week.)—Translations from the work "Exercices et Narrations," by Lcvrier and Demini; French grammar.

*English*, (2 recitations per week.)—English after the method of Robertson.\*

*Drawing*, (4 recitations per week.)—Linear drawing; India ink sketching; Drawing up of projections (designs) on a certain number of given quantities.

*Practical Exercises in the Physical Cabinet*, (2 recitations per week.)—Determination of specific weights; Exercises with the areometer; Weighing (*pesées*.)

#### FOURTH YEAR.

*Physics*, (1 recitation per week.)—Distilling; Theory and construction of distilling apparatus; Vaporization; Ventilation; Electric telegraph; Degrees of swiftness of the electric spark; Influence of the atmospheric electricity; Conductors; Various telegraphs; Electric movers (*moteurs*) and leaders of electricity (*électro-aimants*;) Electric clockworks.

*Technology of Metals and Woods*, (3 recitations per week.)—Importance of wood in constructions; Resistance, qualities, and imperfections, (defects;) Various constructions; Tools; Brass; Iron; Steel; Copper; Zinc; Lead; Tin; Preparing, refining, and working of metals; Molding; Materials used in the manufacture of molds and crucibles; Casting; Construction of ovens and the way to use them; Reflecting ovens; Leakage; Farriery; Locksmith's work; Tools used, and the most practical way for working iron and steel; Theory of the action of instruments on the worked surface; Manufacture of steam-boilers; Arrangement of workshops; Division of labor; Testing of steam-boilers.

*Analytical Chemistry*, (1 recitation per week.)—Alcoholmeter; Analysis of vegetable substances; Study of sediments, (*fecula*;) Analysis of gases; Study of the various materials used for fuel.

*Anatomy and Physiology of Plants*, (2 recitations per week.)—Vegetable structure; Cellular tissue; Functions of the root, trunk, and leaves; Circulation of the sap; Respiration of plants; Temperature; Budding; Assimilation of nutritive substances; Reproduction of phanerogamic plants; Reproduction of agamic and cryptogamic plants; Maladies of plants; Examination of the different systems of botanical classification; Scientific description of plants.

*Industrial Statistics*, (1 recitation per week.)—Social laws; Theory of the development of population; General considerations; Productive forces of Russia; Mining industry; Agriculture; Arboriculture; Bect-culture; Flax; Hemp; Cotton; Cattle-raising; Skinner's trade; Wools; Fats; Minerals; Metals; Vegetable substances; Tar, resin, &c.; Ways of communication; Internal commerce; International commerce; Influence of tariffs.

*Technology of Textile Materials*, (3 recitations per week.)—Cotton; Flax;

\* The instruction in foreign languages takes place at different hours, and in the intervals between the other lessons, in order to facilitate the study of these three languages; but in order to obtain the title of "technologist," it is sufficient to know one of these languages thoroughly.



Hemp; Wool; Silk, &c.; Preparing and gathering of these materials; Description of machines used in transforming tissues; Manufacture of thread, cloths, ribbons, &c.

*Technology of Alimentary Substances*, (2 recitations per week.)—Starch; Alcohol; Beer; Beet-sugar; Refining of sugar, &c.

*Dyeing*, (1 recitation per week.)—Study of colors; Preparing cloths, &c., for dyeing; Theory of fixing the coloring substances; Mixing and combining of colors.

*Applied Mechanics and Construction of Machines*, (7 recitations per week.)—Mechanism of machines; Valves; Pistons; Ropes; Chains; Hasps; Pumps; Draining-wheels; Chain-pumps; Archimedes' screw; Spiral pumps; Suction-pumps; Forcing-pumps; Hydraulic press; Accumulator; Cornwall draining machines; Blowing machines; Cylindrical bellows; Apparatus for heating air; Regulators of atmospheric machines; Blowing machines, with turning pistons; Centrifugal and other ventilators.

*Theory of the Application of Mechanics to Heat*—Apparatus for the formation of steam; Apparatus for distributing steam; Movable mechanisms for steam-engines; Locomotives; Different systems of boilers for steamships; General observations on the progressive motion of steam-engines, and the way of directing them; Mills.

*Practical Exercises in the Physical Cabinet*, (1 recitation of two hours per week.)—Rectification of thermometers; Barometrical observations; Testing and rectification of barometers, areometers, alcoholmeters, &c.; Determining the weight, volume, and mass of bodies (substances;) Testing of gauged vessels and sized instruments; Hygrometric observations; Photometry; Strength of galvanic fluids; Determining the quantity of carbonic acid contained in the air, &c.

*Technical Projections*, (1 recitation per week.)—Drawing up of projections and plans for manufactories of various kinds, &c.

The mechanical section devotes 4 lessons a week, (3 hours each,) and besides this, one whole day for practical exercises in the workshops, which are well supplied with all the necessary materials, tools, steam-engines, &c. The chemical section devotes the same amount of time to analytical exercises or the preparation of various products used in arts and industry.

The Institute has, besides the various workshops, forges, a magnificent chemical laboratory, and very complete physical and mineralogical cabinets.

A library (constantly increasing) of 15,000 volumes, referring to arts and industry, is daily open for the use of the students.

It is a noteworthy fact, that the models of machines, most of the instruments, the reproduction of works of industrial art on a reduced scale, which form the very large and interesting collection of the technological museum at St. Petersburg, have been made in the Institute by the pupils themselves.

#### POLYTECHNIC SCHOOL AT RIGA.

The *Polytechnicum* at Riga has a preparatory and a special course. The former is to give instruction in the elements of mathematics and natural history, and will be discontinued, as soon as the secondary-schools in the Baltic provinces, especially the real-gymnasia, have reached a higher standard. On the preparatory course follow in two groups, combined special courses, which aim at a general technical education; and only during the last year there are special courses for the various branches of manufactures. The first group comprises various mechanical and technical manufactures, agriculture and surveying. The combined course lasts one year. The second group comprises machinery, architecture, and engineering. The combined course lasts two years.

In order to be admitted to the preparatory course, the age of 16 years is required, and to enter any of the special courses, the age of 17. Can-

didates for admission must subject themselves to an examination; those, however, excepted who have, on leaving a gymnasium, satisfactorily passed an examination. The following are the subjects required at the examination for admission to the preparatory course: Sufficient knowledge of German to follow the instruction given in that language; general knowledge of history and geography; a fair knowledge of modern mathematics, especially practical arithmetic; some practice of free-hand and linear drawing. Those who afterwards wish to attend the school of commerce, (business-college,) have, besides, to show a satisfactory knowledge of Russian, French, and English. In order to be admitted to the special courses, complete acquaintance with all the subjects taught in the preparatory course are required. The school-fees are 120 rubles per annum; "casual students" (*Hospitanten*) must pay 4 silver rubles annually for every weekly recitation.

The preparatory course embraces: Elementary arithmetic and mathematics, 10 hours per week; physics and elementary mechanics, 6 hours; free-hand drawing, 6 hours; zoölogy and botany, 4 hours. Those who afterwards wish to attend the school of commerce, ("business college,") have only 4 hours mathematics and 6 hours drawing per week, but instead, 2 hours each for French, English, Russian, and German, and one hour for calligraphy. The special course for merchants (business college) is as follows, with the number of hours per week for each subject:

	I Course.	II Course.
German, .....	2	—
English, .....	2	4
Russian, .....	2	4
French, .....	2	4
Commercial Arithmetic, .....	4	2
Commercial Correspondence, .....	2	3
Science of Commerce, .....	2	2
Commercial Geography and History, .....	3	—
Book-keeping, .....	2	2
General Chemistry, .....	4	—
Popular Mechanics, .....	4	—
Mineralogy and Geology, .....	—	3
Technology, &c., .....	—	4
National Economy, .....	—	2
Laws of Commerce, Exchange, &c., .....	—	4
	<hr/>	<hr/>
Total, .....	29	34

The course of manufactures, agriculture, and surveying, comprises the following subjects, with the number of hours per week:

General Chemistry, .....	4
Popular Mechanics, &c., .....	4
General Architecture, .....	4
Practical Geometry, (Winter half-year), .....	3
Drawing of Plans and Maps, (Summer half-year), .....	8
Drawing of Machinery, .....	6
Architectural Drawing, .....	4
Physics, .....	4
	<hr/>
Total, .....	37



The special course for manufactures, mechanics, and chemistry, embraces the following subjects and hours per week :

Mineralogy, (Winter half-year),.....	4
Geology, (Summer half-year),.....	8
Chemical Technology, I Course,.....	3
Mechanical Technology, I Course,.....	5
Drawing of Plans of Buildings for Manufacturing Purposes,.....	10
National Economy,.....	2
Book-keeping,.....	2
Practical Course in Chemical Laboratory,.....	6

Besides this in the supplementary course : Chemical technology, II Course, 4 hours ; practical course in the physical laboratory (during the winter half-year,) 4 hours ; practical course in the chemical laboratory, 22 to 26 hours.

The special course for agriculturists comprises the following subjects :

Mineralogy, (Winter half-year),.....	4
Geology, (Summer half-year).....	8
Chemical Technology, I Course,.....	3
Mechanical Technology, I Course,.....	5
Physiology of Animals and Plants,.....	5
Architectural and Machine Drawing,.....	4
National Economy,.....	2
Book-keeping,.....	2
Practical Course in the Laboratory,.....	6

The agricultural course is not intended to be a special school in the proper sense of the word, but is limited to imparting a preparatory knowledge of those branches of natural sciences and technology, which are most essential for the agriculturist. A proposition is therefore now under consideration to organize a special course, in which the following subjects are to be taught: Agriculture, culture of meadows, forest-culture, agricultural chemistry, breeding of cattle, veterinary surgery, agricultural architecture, and knowledge of agricultural machines.

The special course for surveyors embraces the following subjects: Mineralogy, geology, chemical technology, practical geometry, surveying, drawing of plans and maps, national economy, and book-keeping.

The course common to machinists, architects, engineers, and surveyors, embraces the following subjects and hours per week :

I Year.	1st		2d		II Year.	
	Half-year.		Half-year.			
Higher Mathematics,.....	6	..	6	..	General Knowledge of Machinery,.....	4
Repetitions,.....	5	..	—	..	General Architecture,.....	4
Theoretical Geometry,.....	3	..	—	..	Mineralogy, (Winter half-year),.....	4
Constructions.....	6	..	—	..	Geology, (Summer half-year),.....	8
Practical Geometry.....	3	..	—	..	Chemical Technology,.....	3
Drawing of Plans and Maps,.....	—	..	8	..	Construction of Machinery, (1st course),.....	5
General Chemistry,.....	4	..	4	..	Machine Drawing,.....	6
Theoretical Mechanics,.....	—	..	8	..	Architectural Drawing,.....	4-6
Repetitions,.....	—	..	5	..		
Physics,.....	4	..	5	..		

The special course for the construction of machinery embraces the following subjects, and the hours per week for each :

	1st Half-year.	2d Half year.
Mechanical Technology, (1st course),.....	5	5
Construction of Machinery, ( <i>Maschinen-bau</i> ), 2d course, .	5	3
Architectural Constructions,.....	4	4
Construction of Machinery,.....	16	20
National Economy,.....	2	2
Book-keeping,.....	2	2

In the supplementary course the following subjects are taught : Analytical mechanics; construction of machinery, (*maschinen-bau*), 3d course; mechanical technology, 2d course; mathematical physics; drawing of plans for machinery; construction of roads, bridges, canals, &c.; drawing of plans and maps, modeling in wood.

The special division for architects has the following course :

	Summer Half-year.	Winter Half-year.
Civil Architecture, .....	5	5
Architectural Statics,.....	4	—
History of Architecture, .....	2	2
Lithotomy and Perspective,.....	3	—
Architectural Constructions,.....	10	10
Ornamentics,.....	2	2
Modeling in Wood, Clay, and Plaster of Paris,....	6	6
National Economy,.....	2	2
Book-keeping,.....	2	2

In the supplementary course are taught : Civil architecture, 6 hours in the summer half-year, none in the Winter; mechanical technology, 5 in Summer and 5 in Winter; construction of roads, bridges, and canals, 5 in Summer and 5 in Winter; drawing of plans for buildings, 12 in Summer, 20 in Winter; drawing of maps and plans, none in Summer and 8 in Winter; modeling, 8 in Summer and none in Winter.

The special school for engineers has the following course :

	Summer Half-year.	Winter Half-year.
Construction of Roads, Bridges, Canals, &c., (1st course,) .	5	5
Civil Architecture, (1st course,) .....	4	4
Architectural Statics,.....	4	—
Mechanical Technology (1st course),.....	5	5
Mathematical Physics,.....	2	—
Construction of Roads, Bridges, Canals, &c., (2d course,) .	10	16
National Economy, .....	2	2
Book-keeping,.....	2	2

The supplementary course embraces :

	Summer Half-year.	Winter Half-year.
Construction of Roads, Bridges, Canals,.....	6	—
Drawing of Maps for Roads, Bridges, &c.,.....	16	20
Lithotomy and Perspective, .....	3	—
Surveying,.....	4	—
Drawing of Maps and Plans, .....	—	8
Ornamentics,.....	2	—
Modeling, .....	—	6
Method of the smallest squares,.....	—	3

The special course for surveyors embraces the following subjects :



	Summer Half-year.	Winter Half-year.
Astronomy,.....	4	4
Method of the smallest squares, ( <i>Methode der Kleisten Quadrate</i> ),.....	—	3
Surveying,.....	4	—
Mathematical Physics,.....	2	—
Drawing of Maps and Plans, .....	16	20
National Economy,.....	2	2
Book-keeping,.....	2	2

There are also winter courses at the technical institute for young tradesmen and mechanics. The former aims at giving the clerks in the various business establishments of the city a chance of acquiring a knowledge of the elements of special instruction. The winter course for mechanics comprises the following subjects :

	Higher Division.	Lower Division.
Arithmetic,.....	4	4
Construction of Buildings,.....	4	4
Drawing and Modeling, .....	12	12
Business Composition,.....	2	—
Book-keeping, .....	—	2

The scholars may only take instruction in one or in all of the subjects, but after having once chosen their subjects, they are bound to attend the recitations of the same. The school-fee is 6 rubles per annum.

#### MINING SCHOOLS.

The mining-schools are classified : lower, middle, and higher. Those of the first class are intended for the elementary instruction of children of mechanics and lower officials, and are, therefore, properly speaking, primary-schools, with the only difference that in these schools drawing is likewise taught. The schools of the second class aim at preparing young men for lower officials in the administrative and economical departments of mining, and there is one in every mining district.

The higher "Institution for Mining Engineers," at St. Petersburg, will compare favorably with the German mining-schools or the *Ecole des Mines* in France. This institution was founded by Catharine II in 1773, and was reorganized in 1834. It is composed of 2 divisions, each of 4 classes. The first division is a preparatory course, and the second a special one. Some of the students study at the expense of the government; others at their own, and some at that of various private mining companies. After having finished the theoretical course, the pupils are sent to the mines for two years. The museum in connection with this institution is very extensive and well arranged. The technical school of mining at the Technological Institute of St. Petersburg, (founded 1834,) aims at educating the mechanics, who are wanted in mining.

Besides these public institutions, under the Ministry of Finance, there are some private ones founded by the wealthier proprietors of mines, such as a mining-school with 5 classes at Nichni-Taglisk, founded in 1806 by privy-councilor Demidow.

Under the control of the Ministry of Finance there are, altogether, 64 institutions of learning, with 5,752 scholars. We have information only concerning the Commercial Academy.

#### COMMERCIAL ACADEMY.

The *Commercial Academy* at Moscow, through the efforts of privy-councilor Walujew, was founded in 1810, chiefly by voluntary contributions. The course of study embraces the following subjects: Religion, history, statistics, natural history, geometry, algebra, physics, chemistry, commercial arithmetic, book-keeping, technical mechanics, technology, Russian, German, French, modern Greek, Latin, calligraphy, and drawing.

The number of pupils was 30 in 1810, and now, (1865,) 289.

#### SCHOOLS OF AGRICULTURE AND FORESTRY.

The *Agricultural and Forest Academies* are subordinate to the Ministry of the Imperial Domains. There are schools for viniculture, horticulture, culture of bees, sheep, &c. A higher agricultural academy is on the imperial domain Gorygoretsk, in the government of Mohilew, and recently a second one has been founded near Moscow. The academy at Gorygoretsk has two divisions for theoretical study, and a model-farm for practical studies. The course in the first division embraces: Religion, grammar, drawing, planimetry, surveying, breeding of cattle, horticulture, forest-culture, &c.; and in the second: Physics, chemistry, botany, veterinary surgery, history, and agricultural statistics. The total number of agricultural schools in Russia is 20, with 857 students.

Since the year 1800, the government has devoted some attention to instruction in forest-culture. In 1803 and 1804, Forest-academies were founded in Czarsko-Sélo and Kozelsk, which were united in 1813, and transferred to St. Petersburg. The Forest-institute consists of 6 classes. The forest-school at Lissina, (more for practical studies,) some special courses of forest-culture at the gymnasiums, and four lower forest-schools, complete the list. All these schools were attended by 599 scholars, and are under the jurisdiction of the Department of Forests, in the Ministry of the Imperial Domains.

#### SCHOOLS OF LAW, SURVEYING, AND TOPOGRAPHY.

The Ministry of Public Justice has the superintendence of the *Imperial Law-school*, the *Constantinian School of Surveying*, and the *School of Topography*. The course at the Law-school embraces the following subjects: Religion, sacred history, general and Russian history, mathematics, natural history, physics, Russian, Latin, French, German, logic, psychology, cyclopedia of jurisprudence, Russian law, Roman law, drawing, calligraphy, singing, dancing, and gymnastics. Students on leaving are obliged to serve 6 years in the Ministry of Public Justice.

The *Constantinian School of Surveying* is intended to furnish surveyors for the government. There are at present in this institution 266 scholars,



who, after having finished their studies, are obliged to serve the government as surveyors for 6 years.

Besides the above school, under the same ministry, there is a Training School for copyists in government offices, with 7 teachers.

#### SCHOOLS FOR THE CIVIL AND DIPLOMATIC SERVICE.

The *School of Oriental Languages*, under the superintendence of the Ministry of Foreign Affairs, was established by Nesselrode in 1829, to educate interpreters for the Russian embassies in the East. The number of pupils is at present 7, who have an annual salary of 1,000 rubles, and live in the institution. No one is admitted who is not a native Russian, of noble family, and has completed the course at a Russian university. The course of instruction embraces: Arabic, Turkish, Persian, history, geography, literature of the Oriental countries, French, and Italian. The course occupies 4 years, after which the students are sent to Constantinople for one year, to gain more practice in the Turkish language. There is a very large collection of valuable Arabic, Persian, and Turkish manuscripts in connection with this institution.

Under the superintendence of the Ministry of Public Instruction there are, besides the universities, two other higher institutions of learning, viz., the Davidow Lyceum at Jaroslavl, and the Lyceum of Prince Besborodko at Njeschin. The object of these institutions is chiefly to educate suitable men for the civil service. In a three years' course the following subjects are taught: History, philology, physics, mathematics, jurisprudence. The number of professors is too small, and the funds and apparatus insufficient. The separate subjects taught at Jaroslavl are: Religion, physics, chemistry, technology, agriculture, forest economy, surveying, zoölogy, botany, mineralogy, cyclopedia of jurisprudence, laws of the empire and of special administration, laws of finance, political economy, statistics, commercial science, civil and criminal laws, German, Russian, and French. Quite a number of professorships were vacant in the year 1864. In the same year the number of students was 33, and the expense for 1865 estimated at 13,828 rubles.

The lyceum at Njeschin is in a somewhat better condition. It was sanctioned by a statute of 1840. The course of studies embraces religion, criminal law, Russian history and statistics, civil laws, cyclopedia of jurisprudence, Russian literature. The number of students in 1864 was 72, and 12,973 rubles were granted for the expenses of 1865.

#### SCHOOLS OF CIVIL ENGINEERS, ARCHITECTURE, AND TELEGRAPHS.

Under the superintendence of the Department of Public Roads, Bridges, Canals, and Public Buildings, there are three schools: (1,) the School for Civil Engineers; (2,) School of Architecture, and (3,) the Signal-School in connection with the administration of the telegraphs. Unfortunately no recent statistics have been obtained concerning any of these schools.

## AGRICULTURAL SCHOOLS.

Since the brief notice of the Special Schools of Agriculture was drawn up from such material as we had at hand, we have received the Report of the Jury of the Paris International Exhibition of 1867 on Agricultural Instruction, from which we make the following extracts:

As Russia is above every thing an agricultural country, she stands in special need of institutions designed to spread among the masses of the population a rational knowledge of agriculture and the sciences relating to it. And it is but just to add, it is one of the European countries where the greatest efforts for the foundation of special schools of this class have been made in the last half century.

Besides the establishment of the magnificent School Strogonof, for arts and design, and of the industrial schools, the Russian government has organized, or encouraged the establishment of a large number of agricultural schools. In the year 1824 an intermediate school was opened at Marjino, where agriculture, forest-culture and surveying were taught. In 1828 a special school was created for bee-culture. In 1833 St. Petersburg received a superior agronomic school, which served as a model for the one subsequently founded at Moscow. In 1836 an establishment was opened at Gorigonetz, comprising the primary, secondary and superior degrees of agricultural instruction. Later schools of horticulture, farming-schools, a large number of model farms, special schools for flax-culture, were created at all points of the vast empire, in accordance with the nature of the soil, and the habits and wants of the population.

The emancipation of the serfs has recently necessitated a radical change in agriculture; there could be no longer any question of antiquated proceedings; it had become necessary to enter the road of progress freely, or run the risk of letting agriculture, the basis of the Russian national wealth, dwindle away. For this reason, besides the establishment of an agricultural academy at Moscow and a superior school of agriculture at St. Petersburg, Russia has completely reorganized all her secondary agricultural schools, and increased her model farms in every direction.

The creation of a remarkable agricultural museum at St. Petersburg, which is daily open to the public, has doubtless contributed much by visitors to the capitol to spread throughout the whole country useful knowledge in various branches of the science of agriculture. Secondary museums have been established in various parts of the empire, and these institutions will doubtless help in realizing the happy idea conceived by the Ministry of Domains.

This administration has exhibited in different classes of the Russian section, documents on the secondary schools of agriculture, the agronomic schools in the Caucasus, the agricultural institution of Lesnoy, near St. Petersburg, and on the academy of Petroskaé, near Moscow. We will endeavor to give an idea of these different establishments by entering into some details, which will show with what liberality and success agricultural instruction is organized in the empire.

There are secondary schools of agriculture at Moscow, Kasan, Saratow, Kharkow, and Gorky, (Government of Mohilew;) besides these there are schools of horticulture at Ouman, Kiew, Voronesch, and Orel. There are schools of vineculture at Kischinew, (*Bessarabia*,) and at Magalatsch, in the



centre of Russia. Every agricultural establishment numbers 100 to 150 pupils. Connected with these institutions there are workshops for cabinet-makers, carpenters and locksmiths; a forge, a chemical laboratory, a physical cabinet, and a small museum of agricultural machines, mostly manufactured by the pupils themselves. Near every school there is a model farm provided with a complete collection of rural constructions, agricultural implements, cattle, and the land required for experiments. The programme of instruction in these schools comprises religion and morals, natural sciences, arithmetic, Russian language, geography, history, and drawing. The course lasts five years, and according to the locality every secondary school is allowed an annual sum of 40,000 to 60,000 francs by the Ministry of Domains and Agriculture.

After the conquest of Caucasia, Russia and the agronomic society of the annexed country founded agricultural establishments, which have produced very satisfactory results, partly owing to their favorable location, partly to the enlightened zeal of their professors. We shall briefly mention some of these establishments.

The "school-farm" of Latschino, near Tiflis, located on the property of Baron Nicolai, numbers 22 pupils. The course of instruction embraces practical agriculture, geometry, surveying, horticulture, arboriculture, bee-culture, vineculture, the raising of cattle, &c. Every thing in this establishment is gratuitous, board, clothing, instruction. Moreover, every pupil receives 200 francs the first year, 320 the second, 360 the third, 400 the fourth. The agronomic society of Caucasia pays all the expenses.

At the school of horticulture at Tiflis, instruction is given in all the subjects relating to this specialty. The duration of the studies, which are entirely gratuitous, depends entirely on the parents.

At Kachétie there is a school of vineculture, which is organized exactly on the same plan as the school at Tiflis. At Routais and at Stawropol, there are schools of horticulture and arboriculture, and at Weadikarkas there is a free school of agriculture, which is not supported by the State, and which is nevertheless in a very satisfactory condition.

The superior agricultural institute of Lesnoy has existed for thirty-five years at Gorky, (Government of Mohilew,) and only since 1863 it has been transferred to its present locality, near St. Petersburg. Its object is to train professors for the secondary schools of agriculture. Only such are admitted as students who have finished their studies at a gymnasium and a secondary agricultural school. There is a three years' course, and every student is obliged to attend the theoretical courses and to work in the chemical, physical, technological, and botanical laboratories. The programme of studies is very complete, and comprises chemistry, physics, mineralogy, botany, zoölogy, mathematics, surveying, mechanics, architecture, technology, agriculture, zoötechnics, forest-culture, rural economy, political economy and statistics.

The Agronomic Institute possesses land to the amount of 30 hectares, (1 hectare = 2.47 acres,) destined for nurseries and experiments. The administration of the government domains allows an annual sum of 250,000 francs for the institute of Lesnoy. During the three summer months, (June till September,) the students, accompanied by a special professor, make botanical, mineralogical, and agricultural excursions. The number of professors is 15, that of the students 90. Every student pays annually 120 francs for the privilege of working in the laboratories.

The Academy of Agriculture and Forest-culture at Petroskaó was founded in 1865, at a short distance from Moscow. It is a superior institution designed for theoretical and practical instruction in the agricultural sciences. The course in each faculty is fixed at three years. Every one who pays for each term (three terms during the year) the sum of 50 francs is admitted to the course. The students can rent a furnished room in buildings specially erected for that purpose by the government. The price of a furnished room is 16 francs per month. There is also a restaurant, whose very moderate charges are fixed by the administration, which also controls the quality of the food. There are 18 professors. The programme of studies comprises agriculture, zoötechnics, veterinary surgery, rural constructions, civil engineering, political economy, forest-culture, agricultural and forest technology, general and applied chemistry, physics, meteorology, botany, surveying, zoölogy, mineralogy, geognosy, and industrial drawing. Connected with this school are a special library, an agricultural museum, a technological and physical cabinet, a collection of models; mineralogical, botanical, zoölogical, dendrological collections, and a vast laboratory. Finally, in order to join practice to theory, the academy possesses a model-farm of 400 hectares, comprising a dairy, barns, stables, a large number of cattle, every variety of agricultural implements, a forest of 150 hectares, a fruit-garden, a nursery, a kitchen-garden, a botanical garden, conservatories and hot-houses. At the end of these theoretical and practical studies, the academy confers two degrees. In order to get the diploma as bachelor, the student is obliged to undergo an examination in all the sciences relating to agriculture and forest-culture; he must moreover hand in to the council a scientific essay on some given subject. In order to obtain the diploma as "master of sciences," the student must present his diploma as bachelor, undergo a second examination, and publicly defend some thesis.

In 1866 the number of students was 450, 85 of whom, on account of their limited means, received a stipend of 100 francs. The total annual budget of this magnificent establishment exceeds 500,000 francs.

In consideration of the powerful and complete organization which Russia has given to her agricultural institutions, the International Jury has accorded a silver medal to the various ministers who have been instrumental in the establishment of special schools of agriculture. This reward would have been still greater if the Russian government had exhibited specimens and documents which would have enabled the jury to judge of the primary and secondary instruction given to children and adults in the vast empire.

#### *Agricultural Schools in Finland.*

The administration of the Grand Duchy of Finland has recently established ten agricultural schools in the different provinces, besides a higher academy at Mustiala, in the province of Wasa. It has two courses: the *first* is practical, and receives 40 pupils, who receive instruction in veterinary surgery, cattle-breeding, and the management of a farm, as well as board and lodging free of expenses. One-fourth of the number are admitted by promotion from the local schools. The *second* course includes geometry, surveying, mineralogy, zoölogy, and other sciences; to which 24 students are admitted, who pay an annual fee of \$125.



## PUBLIC MUSEUMS AVAILABLE IN TECHNICAL INSTRUCTION.

## I. ST. PETERSBURG.

The most important public museums in Russia, which are directly available or indirectly serviceable in technical instruction, are at St. Petersburg and Moscow. Those in St. Petersburg are as follows: 1. The Hermitage. 2. The Museum of the School of Mines. 3. The Museum of Natural History. 4. The Museum at the Agricultural College. 5. The Industrial Museum. 6. The Technological Institute. 7. The Museums of the Ministry of Crown Domains. The gallery of the Imperial Academy of Fine Arts is not included.

1. *Collections at the Hermitage.* This edifice, once a palace, is now the receptacle of the Imperial art treasures. It contains in its large, beautiful and well lighted apartments, a number of collections of objects of art and antiquity. The most interesting of the latter is the "Kertch Antiquities," consisting of an assemblage of articles of Greek, Scythian Greek, and Roman work found in the neighborhood of Kertch, where was anciently situated Panticapæum, the capital of the Cimmerian Bosphorus. Among these are many articles of delicate and beautiful workmanship in gold, enamel, and glass. There is also a collection of Scythian antiquities from those parts of the Scythia of Herodotus not included in the Crimea. One very interesting feature in these is the illustration of the union of Scythian with Greek art.

The other collections in the building are a choice, though small collection of ancient sculpture, of fictile vases, of paintings, of gems, a rich collection of coins, and of art treasures of historical interest, among which are very many interesting relics of Peter the Great. The collections of vases and of gems are among the finest in the world. The whole collection is one of the finest in the world for instruction in art, and is freely open to visitors and students. The collection of paintings has been fully described by Dr. Waagen.

2. *Museum of the Imperial School of Mines.* In the museum is a very large collection of minerals, many of them splendid specimens, and models of mines and mining tools and machinery. In one large room, the distinctive minerals and fossils from each department of the empire are arranged together, affording great facilities for the study of each separately. The products of the Russian mines and modes of working are well illustrated. The entire collection is used in the instruction of the corps of military cadets, who are trained in this school to inspect and direct the imperial mines.

3. *The Museum of Natural History* is in the Academy of Sciences. It is of considerable extent and admirably arranged. Especially interesting is its large series of fossil remains of mammoths. This and the other museums are very much visited; at the time of Prof. Archer's visit there were upwards of 400 present in the different rooms.

4. *Museum at the Agricultural College.* This institution is situated a little out of the city, in the midst of an experimental farm of eighty acres. There is an agricultural library connected with it, and special museums for each branch taught, each in the class-room of the professors of that branch. These are

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\* Report of Professor T. C. Archer, of the Edinburgh Museum of Science and Art, to the Department of Science and Art of the Committee of Council on Education, London, 1866.

botany, zoölogy, geology, natural philosophy, and agricultural produce and implements. The botanical museum contains a large herbarium of plants having special relations to husbandry; the zoölogical museum, well stuffed specimens of animals, useful or obnoxious to the farmer; that of natural philosophy, apparatus illustrating the various phenomena of meteorology, hydrostatics, &c. That of chemistry contains the results of analyses of various products, showing their relative value as food. The buildings form a quadrangle upwards of 500 feet in length, and altogether cover two acres and a half. The school with which it is connected is one of the best organized and administered in Europe.

*The Industrial Museum* or Museum of Rural Economy forms part of an institution intended to diffuse a knowledge of the sciences connected with the production and utilization of substances required for food, and contains a collection of various articles of food, animal and vegetable, for man and the domestic animals. There is also a department for mechanical and engineering draining and farming appliances, and an agricultural library. Free lectures are given in this museum.

5. *Museum at the Technological Institute.* The technological institute contains, besides a large technological library, a large number of models, &c., illustrating mechanical and civil engineering, made by the pupils in the extensive workshops. The general arrangement is the same as that of the Museum of the *Conservatoire Imperial des Arts et Métiers* at Paris. Like that, it is well supplied with steam-power to work the extensive assortment of engineering tools and machines which it contains.

## II. MOSCOW.

Moscow contains several very interesting Museums, among which we will mention the following:

1. *The Treasury of the Kremlin.* In this is the richest collection of works in metal, such as regalia, chalices, ornamental table work, enamels, jewelry, embroidery, leather-work, &c., in the world. Among these, besides specimens of Russian work, are some of English work of the beginning of the seventeenth century, and some remarkable pieces of Benvenuto Cellini's workmanship. There is a curious and extensive collection of Russian banners and ensigns. The arrangement of the Museum is chronological, and there is an excellent illustrated catalogue. As an appendage to this collection, which has a national character, may be mentioned the curiosities in the house of the Tzar Romanoff, the founder of the reigning dynasty.

2. *The Roumiantsoff Museum* or Public Museum of Moscow, contains a picture gallery, library, zoölogical and ethnological collections, a small but very interesting cabinet of Christian antiquities, and a mineralogical department of considerable extent. It is held in a large and magnificent palace.

3. A School of Art is now forming in Moscow, with a large collection of drawings from ancient Russian art and architecture, as well as models, casts and drawings in detail of the choicest specimens of art in different countries, on a plan similar to that of the Museum at South Kensington, in London.

All of the collections are scientifically arranged, and can be consulted with carefully prepared catalogues.



## SPECIAL INSTRUCTION IN SWITZERLAND.

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### INTRODUCTION.

THE Republic of Switzerland, on an area of 15,233 English square miles, had, according to the last census (1860,) a population of 2,510,494 inhabitants. Out of this number there are 1,900,000 individuals supported by agriculture, 180,000 persons by manufactories, and 150,000 by handicrafts. In the Canton of Basle the manufacture of silk ribbons to the value of about \$7,000,000 occupies 6,000 persons; in the Canton of Zurich, silk stuffs to the value of 8,000,000 are made by 12,000 operatives. The manufacture of watches and jewelry in the Cantons of Neuchâtel, Geneva, Vaud, Berne, and Soleure, occupies 36,000 workmen, who produce annually 500,000 watches, valued at \$9,000,000. In the Cantons of St. Gall and Appenzell, 6,000 workers make \$2,000,000 worth of embroidery annually; the printing and dyeing factories of Glaris turn out goods to the value of \$30,000 per annum. The manufacture of cotton goods occupies upwards of 1,000,000 spindles, 4,000 looms, and 20,000 operatives, besides 38,000 hand-loom weavers. Straw-plaiting in the Cantons of Argovia, Lucerne and Basle employs 30,000 persons, and machine-building, principally at Zurich, 6,000. In many of these occupations, agricultural labor is combined with factory work. Out of 485,000 heads of families, not less than 465,000 possess landed property.

Switzerland, formerly a league of semi-independent states, became a united confederacy under the constitution of 1848. The present constitution, the product of a short civil war, bears date September 12, 1848. It vests the supreme legislative and executive authority in a parliament of two chambers, viz., the State-council (*Ständerath*) of 44 members, and the National Council (*Nationalrath*) of 128 members. The chief executive authority is deputed to a Federal Council (*Bundesrath*), consisting of seven members, elected for three years by the Federal Assembly.

## PUBLIC INSTRUCTION IN SWITZERLAND.

### I. PRIMARY INSTRUCTION.

There are 7,149 elementary schools, with 363,682 scholars and 7,190 teachers. In most of the Cantons there are repetition schools, infant schools, and female industrial schools; in some also adult courses. There are 59 higher elementary schools (district-schools,) with 2,148 scholars.

### II. SECONDARY INSTRUCTION.

There are 177 real-schools of different grades, with 7,039 scholars; 7 progymnasia, with 328 scholars; 12 gymnasia, with 1,619 scholars; 17 cantonal schools (the highest grade of secondary schools, each comprising a gymnasium and a real-school,) with 3,794 scholars; making a total of 213 secondary schools, with 12,780 scholars.

### III. SUPERIOR INSTRUCTION.

There are 3 complete universities (each with 4 faculties, viz., theology, law, medicine, philosophy)—Basle, Berne, and Zurich, with a total of 631 students and 126 professors; 2 academies (with 3 faculties each, viz., theology, law and philosophy,) with a total of 405 students; 2 faculties of theology, with 24 students (at Solcure and Lucerne,) and 2 law-faculties (at Fribourg and Sion,) with 36 students; making the total number of 234 theological students, 225 law students, 255 medical students, and 370 students of philosophy.

### IV. SPECIAL AND PROFESSIONAL SCHOOLS.

The Federal Polytechnic School at Zurich, in a building erected at the sole expense of the Canton of Zurich (over \$500,000), with extensive laboratories, and collections for illustrating every department of instruction, employs 57 professors, masters and teachers, in seven schools, viz., of architecture and construction, civil engineering, mechanics and machinery, industrial chemistry, forestry and rural economy, moral and political science, and the fine arts. The Federal Assembly makes an annual appropriation of \$40,000 towards the expenses of this school, on account of its benefits to the industrial interests of Switzerland. Besides this Industrial university, there are:

- 1 Military institute at Biere.
- 1 Technical institute at Lausanne.
- 90 Industrial schools for girls.
- 1 School for watchmakers at St. Imier.
- 1 School for weavers at Trogen.
- 1 School of drawing and wood-carving at Brienz.
- 7 Agricultural and industrial schools for boys.
- 15 Seminaries for male primary teachers.
- 7 Male normal primary courses.
- 3 Seminaries for female primary school teachers.
- 20 Orphan schools.
- 10 Infant schools or kindergärten.
- 34 Rescue institutions for neglected children, with 1,543 pupils.
- 2 Institutions for deaf-mutes.
- 1 Institute for the blind.
- 1 Institute for feeble-minded children.



## SPECIAL SCHOOLS AND CLASSES IN SWITZERLAND.

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### TECHNICAL INSTITUTE AT LAUSANNE.

The Technical Institution at Lausanne was established in 1853, for the education of engineers, mechanics, chemists, and architects, in the French cantons of Switzerland. It was established by an association of public spirited citizens, but receives an annual subsidy from the government of Vaud, and from the commune of Lausanne.

The direction is vested in an administrative council, consisting of a president, vice-president, secretary, and four other members.

The studies and internal management are under the immediate charge of a council composed of the director and the heads of each department of instruction.

Candidates must be seventeen years of age, and pass an examination in arithmetic, algebra, descriptive geometry, physics, chemistry, and geometrical drawing, or have the diploma of a secondary school in which these studies are taught. The examination is both oral and written.

Several scholarships are established by the municipality of Lausanne, and free places are provided for by the subsidy from the Canton, in aid of poor but capable pupils; but these scholarships and places are obtained only on competitive examination.

The course of instruction extends over three years, and is pursued according to the following programme :

### COURSE OF INSTRUCTION.

#### FIRST YEAR.

*Geometrical Analysis and Infinitesimal Calculus.*—Recapitulation of rectilinear trigonometry, and application of it to the resolution of problems. Reduction of the angle to the horizon. Reduction of the angle to the centre of the station. The most important formulas of spherical trigonometry. Their application to the resolution of divers cases of the trihedral angle (*l'angle trièdre*). Projection of polygonal outlines on an axis. Plane and solid coördinates.

Representation of geometrie points (*lieux*) by equations. Geometrie point of one equation with two variables. Equation of the straight line. Lines of the second degree. Properties of the ellipse, the hyperbola, and the parabola. Simpson's formulas for calculating the areas of plane surfaces.

Differentiation of the explicit and implicit functions of a single variable. Relations of the increase of two functions of the same variable. Finding of the

true values of unknown quantities. Maxima and minima of the functions of a single variable.

Immediate integration. Integration by decomposition. Integration by substitution. Definite integrals. Quadrature of surfaces. Rectification of curves. Curves of revolution of solids.

The pupils must be well practised in calculation.

*Theoretical Mechanics.*—Movement of a geometrie point.

Graphic representation of the general equations of this movement. Motion of invariable systems. Composition of motions and velocities. Relative motion. Measure of forces. Impulsion of forces. Application of forces (*travail des forces*). Mass of bodies. Movement of a material point. Composition and decomposition of forces applied to a material point. Motion of a material point moving with initial velocity, and subjected to the action of some force or other. Tangential and centripetal forces. Apparent forces in the relative movement of a material point. Composition of forces applied to a rigid system. Couples (*couples*). Motion of forces. Centre of gravity. Geometrie and mechanical properties of this point. Equilibrium of forces applied to a rigid system. Friction. Calculation of amount of friction in some simple machines. Resistance of the air to the movement of a body.

*Descriptive Geometry.*—Revision of the straight line and the plane by the method of orthogonal projections. The straight line and the plane by the method of numbered plans.

Surfaces in general; regulated surfaces; developable surfaces or left surfaces; surfaces of revolution. Of the plane tangent to divers surfaces when the point of contact is given. Intersection of surfaces and delineation of the tangents to the curves.

Of left surfaces in general. Of planes tangent to surfaces when the point of contact is not given.

*General Physics.*—This course comprises special elucidation of subjects bearing upon industry, such as barometry, thermometry, calculations relative to dilatation, elastic forces, and the total amounts of caloric in steam (*chaleurs totales des vapeurs*). Formulas of radiation. Mechanical equivalents of heat, of electricity, of chemical action, &c., &c. Meteorology, &c.

*General Chemistry.*—Study of the principal simple substances useful in arts and industry, and of their principal inorganic and organic constituents. Course of analytical chemistry.

The pupils should be frequently exercised in chemical operations under the direction of the professor.

*Industrial Mechanics.*—Diverse materials employed in the construction of machinery. Principal component parts (*organes*) and joints. *Cinématique*. Organization of workshops for machine building. Mechanical tools. Spinning machines. Accessories of generators, &c. Instruction in making plans of machines and of buildings.

*Building.*—Of the materials used in building. Of their preservation. Manufacture of bricks and tiles, of mortar, of hydraulic and non-hydraulic mortars, and of cements. Plastering. Details of masonry in general. Making plans and leveling.

*Graphic Studies.*—Ornamental designs done with the pen. Architectural drawing. Exercises in washing in colors. Conventional tints. Machine designing. Diagrams (*épures*) in descriptive geometry. Topography.

*Work during the Vacations.*—The pupils must execute plans of buildings, of machines, and of industrial structures, and write a description of them.

These obligatory exercises must be delivered in on the day when the school again reassembles, or they will be considered as not finished.

## 'SECOND YEAR.

### *Special Course.*

*Analytical Geometry and Infinitesimal Calculus.*—Recapitulation of the studies of the first year, with numerous exercises in calculation.

Straight lines and planes. Surfaces of the second degree. Principal properties of these surfaces, deduced from their equations.

Differentiation of the functions of several independent variables. Taylor's



series for the functions of a single variable. Equations of the tangents and normals of curved planes. Length of the tangent, of the sub-tangent, of the normal, and of the sub-normal. Asymptotes. Concavity and convexity of curved planes. Single points. Curves of plain lines. Osculatory curves.

Elements of the differential calculus and its applications to interpolation.

*Theoretic Mechanics.*—General theorems relative to the quantity of momenta, velocities, and masses. The point of inertia and the radius of gyration. The shock of bodies.

Theory of the resistance of materials.

*Hydrostatics.*—Calculation of the pressure of liquids and of gases.

*Hydraulics.*—Movements of liquids and of gases. Calculation of the principal hydraulic receivers.

Calculation of the power of steam engines.

*Descriptive Geometry.*—Rapid recapitulation of the course of the preceding year. Delineation of shadows and perspectives. Cutting of stones and of timber for building purposes.

*Industrial Mechanics.*—Metallurgy of iron. Machines and apparatus used in metallurgic works.

Calculation of the proportions of the parts of machines.

Iron bridges and frame work. Roofings (*combles*).

*Industrial Physics.*—Manufacture of gas for lighting, from coal, from peat, from oils, from water, &c.

Purification. Tubes. Burners.

Measure of the lighting power.

Oil lamps, petroleum lamps.

Electric light, Drummond's light, magnesium light, &c.

*Applied Chemistry.*—Work in the laboratory, bearing on the analysis and study of various questions.

*Architecture.*—I. History of the art of building: Egyptian, Greek, and Roman Art, Latin, Byzantine, and Moorish Architecture of the 11th and the 16th centuries.

Architecture of the *Renaissance* in Italy, France, and Germany.

II. Elements of Edifices: Structures in stone—walls, buttresses, orders of architecture and arcades, vaults, doors and windows, staircases.

Structures in wood—roofings, floors, panneling, joiners' work, &c.

Constructions in iron—locksmiths' work of a coarser and finer kind.

Diverse constructions. On the different modes of covering in buildings, on the distribution of water, &c. Graphic exercises in composition.

## HYDRAULIC WORKS.

*1st Part. Agricultural Hydraulics.*—General considerations as to agriculture, elements of vegetable physiology. Arable lands. Cultivation and fallows. Manures and improvements. The management of water from an agricultural point of view.

Examination of torrents. Works proposed for the prevention of inundations. Embankment of watercourses, and improvement of the beds of rivers. Drainage, irrigation.

Search for springs. Artesian wells. Conduits for supplying water in towns. Filters and reservoirs. Fountains, &c.

*2d Part. Internal Navigation.*—Navigable watercourses, and such as are suitable for floatage. Works necessary for the establishment and the improvement of navigation.

Artificial navigation, lateral and other canals, reservoirs, trenches for conveying water, sluices, &c.

*Roads.*—Ordinary roads and railways. Delineations. Building, and keeping in repair those means of communication.

*Geology.*—Physical geography.

*Graphic Studies.*—Geometrical plans. Mechanical and architectural drawing. Tinting. Graduated plans.

*Work during the Vacations.*—The pupils should visit workshops, finished buildings, or buildings in course of construction, and should closely observe the progress of the work. When the school meets again, they are bound to deliver in a

written account of what they have seen, accompanied by exact drawings or sketches, and by all the notes on which their account is based. These notes should be regularly classified, and be neatly written.

### THIRD YEAR.

#### *Special Course.*

*Architecture.*—I. On Composition : Distribution, salubrity, solidity.

Beauty of proportions, of decorations, and of style.

II. Study of various modern monuments, halls, market buildings, workshops, divers industrial buildings.

Bridges, aqueducts, viaducts, lighthouses, railway buildings.

Town and country houses.

Prisons, hospitals, public baths, &c.

Schools, libraries, and museums.

Theatres, concert-rooms, and circusses.

Religious structures and funeral monuments.

On the laying out and enlargement of towns.

Graphic exercises in composition.

*Construction.*—Foundation works of all kinds, and in all sorts of ground. Description of the various systems in use. Calculation of the supporting walls and the vaults. Stone and wooden bridges. Suspension bridges.

### HYDRAULIC WORKS.

*Harbors.*—Harbors on rivers, lakes, and sea. Conditions of the establishment of a good harbor. Outer works and inner works, such as roads, bars, breakwaters, piers, jetties, quays, &c. Floating basins, docks, &c.

Maintenance of harbors : cleansing, works for building and repairing ships ; careening docks, &c. Lighting of coasts and ports. Lighthouses, harbor lights.

Discussion of divers plans of ports.

*A Course of Law.*—(In so far as it is required by the engineer.) General principles of civil law and administration. More extensive development of certain parts, such as distinction between various kinds of property ; administration of public domains ; the rights of property and their limits ; dangerous industrial establishments ; expropriation for public use ; mining legislation ; increase of property by accession ; usufruct ; legislation as to roads and railways, water supply, drainage, watercourses, irrigation, workshops, manufactories ; boundaries, plans, and registers of lands ; general rules of contracts ; sales, rentings, hirings, workmen, and carters ; estimates and bargains ; undertaking of public works ; civil and commercial associations ; loans and commercial effects ; agents and brokers ; transactions ; privileges and hypothecation ; prescription, &c., &c.

### SECOND AND THIRD YEARS.

These *cours*, divided into two sections, under the designations A and B, are delivered to the united pupils of the second and third years.

Each section is given alternately every second year.

*Industrial Mechanics.* *Section A.*—Means used for the transport and lifting of heavy burdens : rollers, winches, cranes, &c. Management of mines : means and processes adopted.

Hydraulics : construction and placing of wheels and turbines. Machines for raising water. Study of pumps. Raising of water, exhaustion (*épuisements*). Hydraulic presses. Apparatus for ventilation. Windmills. Agricultural machines. Mechanical saw works, &c.

*Section B.*—Steam engines. Thorough study of these machines—calculations, construction, fixing. Steam boilers. Attempts to introduce improvements in steam engines ; divers inventions.

Use of steam in industry. Railways : locomotives and rolling stock. Steam navigation : types of marine engines and boilers. Recent progress in naval architecture, &c.

*Industrial Physics.* *Section A.*—Combustion : reduced heat, radiated heat.

Combustibles : quality, extraction, purification, carbonization. Caloric power, volumes of air, temperature, cost price. Testing of combustibles.



Furnaces : smoke consuming furnaces ; furnaces of particular construction ; gas furnaces.

Movements of the air : formulas of draught (*formules de tirage*) for the chimneys of forges, &c. ; chimneys common to several furnaces. Construction of chimneys. Mechanical attraction (*appel mécanique*) of the air. Resistance of the conduits.

Transmission of heat : laws of transmission in diverse cases. Laws of refrigeration. Application of these to heating in general.

Heating and ventilation of public buildings and private dwelling houses.

Production of cold : fabrication and conservation of ice. Glaciers.

*Section B.*—Distillation : simple, composite, under divers degrees of pressure, with multiple use of heat.

Evaporation : spontaneous in dry air by means of direct heat, by means of steam heating.

Drying : in cold air, in hot air, by radiation by mechanical means. Drying apparatus for combustibles, for pulverescent materials, for textile fabrics, &c. Useful effects of the heat in respect of these various apparatus, and at divers temperatures.

Heating of air : chimneys in dwelling-houses, stoves, hot air, hot water, and steam pipes.

Heating of liquids : baths, washhouses, machines for domestic purposes.

Heating of solid substances : machines for continuous heat, machines for over-heated steam, machines for high temperatures.

#### INDUSTRIAL CHEMISTRY.

*Section A.*—Fabrication or extraction of sulphuric, chlorohydric, and azotic acids, of marine salts, of soda, potassium and saltpetre. Glass manufactories and potteries.

Metallurgy of iron, and of the other most important metals.

*Section B.*—Manufacture of sugar, beer, alcohol, soaps, and fatty acids. Conservation of alimentary substances and of woods. Bleaching and preparation of linens, cottons, wools, and silks. Manufacture of paper. Principles of dyeing. Tanning and dressing skins. Chemical operations.

#### GEOLOGY AND MINERALOGY.

*Section A. Geology.*—General structure of the globe. Phenomena of the surface. Volcanoes.

Sedimentary rocks : stratification. Epochs. Characteristic fossils. Coal fields. Lignites. Gypsums. Mineral salts.

Igneous rocks : form, age, and composition of these rocks. General classification. Metamorphic rocks.

Building materials of these different formations. Chalks and clays.

*Section B. Mineralogy.*—Physical properties of minerals. Crystallography. Study of the most important minerals. Mineralogical study of rocks.

Distribution of metals. Veins of different formations. General laws. Metals in alluvium.

Explorations of mines, and general principles of working and management.

*Plans.*—The pupils of the third year shall execute, from programmes prepared by the professors, and within a certain period, numerous plans for undertakings in connection with the special branch of science which they have selected.

These plans are examined, and their merits determined, in a conference presided over by the professor of the special branch in question.

*Examinations.*—During the three years of attendance at school, the pupils are subjected to partial examinations, and, at the end of the first two years, to general examinations.

All the *cours* are equally obligatory on the pupils, whatever may be the special branch which they have selected as their future vocation.

*Competitive Examinations.*—At the end of the third year, the pupils pass a competitive examination for the purpose of obtaining a *diploma of engineer*.

## INDUSTRIAL SCHOOL FOR GIRLS AT NEUCHATEL.

The Industrial School for Girls at Neuchatel, provides for such pupils as have completed the course of the primary school, with a desire to prepare for a commercial, or teaching career, the requisite knowledge. Among the subjects taught are: the German and French languages, geography and history, drawing (geometrical and artistic), bookkeeping, and business forms and correspondence, natural history and science, needle work and domestic economy, and the art of school organization and management. The course occupies three years, and the cantonal and municipal authorities make an appropriation to reduce the tuition fees.

## SPECIAL SCHOOLS OF GENEVA.

1. *The Industrial School.*

This school has 3 divisions, with a preparatory course of arithmetic. The course of instruction embraces: in the first division, physics, geometry, drawing, ornamentation; in the second division: algebra, chemistry, industrial drawing, bookkeeping; in the third division: natural history, political economy, mechanics, perspective, chemical experiments.

The instruction hours are in the evening, from 6 to 9. The fees are, per half year in the preparatory course, 5 francs; in the 1st div. 10 fr.; in the 2d div. 15 fr.; in the 3d div. 20 fr.; day scholars pay somewhat less. The state pays annually 10,664 francs, (one-third of this sum is paid by the City of Geneva.) There is an annual examination.

2. *School of Watchmaking.*

Formerly females were also admitted to this school, but this is no longer the case. The conditions of admission as to age are: 14 years. The fees are 10 francs per month for Swiss, 20 francs for foreigners. If after three months a pupil shows no aptitude whatever, he is dismissed. The school furnishes all the necessary tools, but pupils are made responsible for them. The instruction hours average 10 hours per day; there is one a month's vacation in summer. No one is admitted into a higher class before he has thoroughly mastered the subjects taught in the preceding class. There are four classes, viz: 1, pinions; 2, finishing; 3, wheel work; 4, escapement, etc. The annual expenses of the establishment amounted to 13,000 francs. There are 4 professors; each with a salary of 2,400 francs.

3. *Schools of the Fine Arts.*

These schools are entirely free; they are divided in the following manner: 1, one class for figure drawing; 2, one class for ornamental drawing and the study of architecture for young men; 3, one class for modeling of figures and ornaments; 4, one class of drawing for young ladies. Every class has five lessons a week, each of two hours. Inhabitants of other cantons and foreigners are only admitted if there are home vacancies; young men are admitted at the age of 14, young ladies at the age of 13. Pupils must find their own drawing materials. At the end of the year prizes are distributed to the best scholars. There are 4 professors, each with a salary of 2,392 francs. The annual expenses of this school amount to 14,428 francs, borne entirely by the city of Geneva.



## FEDERAL POLYTECHNICUM AT ZURICH.

THE SWISS POLYTECHNIC SCHOOL at Zurich originated in a desire to perpetuate the consolidation of the federal union in 1848 by an institution which should at once cultivate the national spirit, and advance the industrial interests of all the Cantons.

Mr. Russell, in his elaborate treatise on *Systematic Technical Education for the English People*, already largely quoted from, remarks:

It is the great extent, completeness, and symmetry every where apparent in the organization of this great technical university, which make it preëminently a model for us; not to copy or imitate merely, but to excel and go beyond. We must determine, as they did, not merely to copy some local institution in another country, which had to be fitted into the existing institutions of an entirely local character, but to supply, in a symmetrical and complete manner, every existing deficiency in the whole national system of higher education. The founders of the Swiss Polytechnicum did not therefore ask themselves the question: What is the smallest and least costly scale on which we can begin to make good a few technical deficiencies?—but they asked themselves this other question: What is there in the science, the philosophy, the learning, the art, and the practical skill of modern times, which can be learned and taught, or which has been taught or learned in any other school of knowledge, but for which there is no adequate provision already made for teaching to our own students in the universities of the land?—and those things we will see to having thoroughly taught. They soon found that the German universities had long been in the habit of teaching far deeper science, far larger philosophy, and far profounder art, than the Swiss in the isolation of their mountains had ever dreamt of.

They found in the manufactories of Prussia, Belgium, France, and England, structures, machinery, and manufacturing processes utterly unknown to the skilled men of Switzerland. What the Swiss did not already know, it was quite plain they would be unable to teach to the young generation; and so the Zurich Polytechnicum had to become, and is a cosmopolitan establishment. The founders and governors of that institution discarded at once the vulgar and pestilent notion of patronage.

There were no places in that university to be given away. What they did, on the contrary, was to search the annals of pure philosophy and applied science, for the names of those men who were best known for science, skill, and love of teaching; and these men from every country they selected, and intreated to come and teach their children, considering only how they could best make it agreeable and convenient to them to become the teachers and patterns of Swiss youth.

When I say that the Swiss were profuse of their wealth for the foundation of this cosmopolitan university, I say a great deal more than these words will seem to imply, when they are read in England. We are a wealthy, profuse, and even, as some think, a wasteful people. The Swiss, on the contrary, lead a hard-working but sparing life—frugal even to the extreme—we might call them niggardly or penurious; but though their personal wants are so easily satisfied, such is their patriotism, and such their love for the well-being of the community in which they live, that to a stranger's eye they might seem extravagant or wasteful. Their common schools are mansions; their academies have the air of town-halls. The Polytechnicum at Zurich is larger than Buckingham Palace; the apartments of students and professors, the lecture-halls and museums, are large, lofty, well aired, well lighted. The building itself is the *chef-d'œuvre* of a German architect; and certainly, if we judge it by its fitness for its purpose, rather than by profuse decoration or lavish embellishment, it is an admirable structure. Even physically, therefore, or materially, it is a model institution, while morally it teaches us this lesson: that there is one nation in the world sufficiently disinterested and patriotic to save money by extreme self-denial, in order to lavish it with profusion upon the intellectual training of the rising generation for the practical duties of citizenship. This



self-denial, generosity, and large wisdom, have been fully rewarded by the issue.\* The youth of the country have flocked with avidity to Zurich, and the young men thus trained are, with equal avidity, taken out into the public works and manufacturing institutions of Switzerland; and whether it arise from this cause or some other, it is an astonishing fact that the Swiss, remote from the sea, that highway of merchandise; remote from coal and iron, those staples of our manufacturing industry; the Swiss in their far vallies are rapidly growing a dexterous and successful manufacturing people.

From us they have taken away our Coventry ribbon manufacture; from Lyons they have appropriated a large portion of their famous silk weaving; in watches and clocks they have long kept the rest of the world going; and their intelligent, educated, skilled men are prized all over Europe. Two hundred and fifty Swiss avail themselves of the advantages of their technical university. But it will be thought a far higher proof of the value of such an institution when I add, that it has attracted students from nearly every civilized country in Europe; and that, of the 589 students who frequent its halls, 250 are Swiss, and the other 339, English, Americans, French, Germans, Poles, Hungarians, Russians, Italians, Dutch, and Belgians.

This technical university is governed by a permanent council, consisting of a president, vice-president, three councilors, three substitutes, and a secretary; and they have immediately under them an executive chosen from among the professors. The president, Kappeler, is the real governor of the institution. He represents also the central government of Switzerland, by whom he is named; and it is on his firmness as a ruler, on his wisdom in the selection of professors and teachers, and on his tact in the management of professors and students, that much of the success of this institution has depended. He happens, fortunately, to have a rare instinct for the discovery of ability in men, especially in young men; and he is continually making search in foreign universities for the rising professor who has not yet obtained adequate distinction at home. He has accordingly surrounded himself with teachers who unite the enthusiasm of youth in teaching, to full knowledge fresh from the fountain of learning. It is one of the evils, however, of this system, that the school becomes a sort of nursery for professors, and that other technical universities are much given to filching away from this, its young and rising men. The system, however, on the whole, works admirably, for there is by this means a continual infusion of young blood to maintain the circulation of fresh thought, and the attractions of the university itself are strong enough to retain in the list of professors men whom the well informed among ourselves will at once recognize as the most distinguished men of their profession.

The vice-president of this institution is Dr. Alfred Escher, a statesman of large views and unquestioned patriotism, who may be regarded as, more than any other individual, the founder of this national institution; while the others are men who have attained the highest distinction in the Canton they represent, some of them well known in England.

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\* Another competent English observer, Prof. Arnold, in the chapter on the schools of Switzerland, in his *Report on Schools and Universities on the Continent*, speaks as follows of the liberality of another town in this Canton:

The town of Winterthur has established higher schools for boys and girls, which, though not cantonal but municipal, emulate the higher schools of Zurich in their organization, and far excel them in their school buildings. It is the most remarkable place for its school establishments in Europe. It is the second town for importance in the Canton Zurich, and thrives by its manufactures of muslins, but it has not more than 8,000 inhabitants. The schools of this small place recall the municipal palaces of Flanders and Italy. They are objects of the first importance, and would be admirable any where. Besides the elementary schools there is a *Mittelschule*, an *Industrie-schule*, and a gymnasium, all built within the last twenty-five years, and which have cost the town not less than £100,000, (\$500,000.) I found eighty scholars in the gymnasium. I heard a class in Livy—the performance was as good as that which I remember in the fifth form of Winchester or Rugby.

The grant from the Canton to the schools of Winterthur is £80 (\$400,) and the town spends \$16,000 a year. The balance of the annual expense is raised by school-fees, which are fixed by law at from 3 francs to 5 francs a year in the primary-schools, and in the higher 24 francs, which constitutes an inducement to punctual attendance. One-half of the avails of the tuition-fees is paid to the teacher, which operates to quicken his zeal to secure the attendance of pupils.



## LAW CONCERNING A FEDERAL POLYTECHNIC SCHOOL, 1851.

The Federal Assembly of the Swiss Confederation in conformity with Article 29 of the Federal Constitution, and after having examined the proposition of the Federal Council decrees:

## I. GENERAL REGULATIONS.

§ 1. A Federal Polytechnic School is erected.

§ 2. The object of the Federal Polytechnic School is to prepare young men theoretically, and as far as possible also practically with a constant view to the special industries, and the public service of Switzerland, viz: 1. Construction of roads, railroads, canals, and bridges. 2. Industrial mechanics. 3. Industrial chemistry.

The Polytechnic School may also be used for the partial education of teachers for technical institutions.

§ 3. Instruction at the Polytechnic School commences with that grade which pupils of the Cantonal and City industrial schools reach.

§ 4. The Polytechnic School is to have three divisions, viz: 1. Civil engineering. 2. Industrial mechanics. 3. Industrial chemistry.

Instruction in two or all three divisions may be given in common, in so far as the special object of each division is not thereby injured.

§ 5. In the *first division* of the Polytechnic School, instruction is imparted in the following branches:

1. Topography and geodesy, with practical exercises and topographical drawing. 2. Building of roads, railroads, bridges and canals, likewise with the necessary practical and graphic exercises. 3. Theory of machines, ("maschin-enlehre.") 4. Analytical mechanics. 5. Architecture, principally of construction, ("constructionslehre.") 6. Mechanical technology. 7. Technical physics. 8. Higher mathematical analysis. 9. Spheric trigonometry and analytical geometry. 10. Descriptive geometry. 11. Elements of astronomy. 12. Geognosy. 13. Free hand drawing.

§ 6. In the *second division* of the Federal Polytechnic School, instruction is imparted in the following branches:

1. Theory of machines. 2. Construction of machines, exercises in making projects and drawing of machinery. 3. Elements of topography with practical and drawing exercises, and elements of geodesy. 4. Elements of road, railroad, bridge, and canal building. 5.-14. The same subjects as those enumerated under No. 4.-13 of the first division.

§ 7. In the *third division* of the Polytechnic School, instruction is imparted in the following branches:

1. Analytical chemistry, with practical exercises in the laboratory. 2. Technical chemistry, with practical exercises in the laboratory. 3. Technical physics. 4. Elementary theory of machines. 5. Mechanical technology. 6. Geognosy. 7. Physiology of plants. 8. Free hand drawing.

§ 8. In the order of the various subjects enumerated in the preceding paragraphs, change may be made if occasion should demand it.

§ 9. Instruction in all divisions of the Polytechnic School is subdivided into courses.

The first and second divisions have each three, and the third two courses. Each course lasts one year. They commence in spring.

§ 10. All the courses of all the divisions are held every year.

§ 11. The distribution of the different subjects of the various divisions in the annual courses, will be settled in a way previously regulated.

§ 12. All subjects of instruction at the Polytechnic School are taught only in one language, either French or German, according to the choice of the teacher appointed for each subject.

§ 13. A fund is created for the Federal Polytechnic School.

§ 14. The sum of four thousand francs is annually paid into this fund. Besides this there is annually paid into this fund, a sum corresponding to the estimate of income and expenditure made at the beginning of the year, from

the Federal Treasury. Donations and legacies made to the Polytechnic School are always added to this fund. Donations and legacies made for special purposes, and not for the Polytechnic School in general, are managed separate from the Federal Polytechnic School fund.

§ 15. The interest of the Polytechnic School fund is to be added to the capital, until the latter has reached the sum of two hundred thousand francs. As soon as this is the case, the interest is used to meet the current expenses of the Polytechnic School.

§ 16. When the Polytechnic School fund has reached the sum of two million francs, no more shall be paid into it from the Federal Treasury.

## II. THE STUDENTS.

§ 17. Students to the Polytechnic School are always admitted in spring, at the commencement of the annual course. Only in exceptional cases can students be admitted in the middle of the course.

§ 18. Students can be admitted to the lower as well as to the higher annual courses of the different divisions.

§ 19. Candidates for admission to the Polytechnic School must be able to produce:—1. A certificate of good moral conduct. 2. To show a sufficient knowledge of the French and German languages, to be able to attend lectures in both these languages. 3. To show a sufficient knowledge of the subjects which is presupposed in candidates for the various divisions. 4. To certify that they have entered the eighteenth year of their age.

§ 20. Every student has to belong to one of the three divisions of the school.

§ 21. As a general rule only those are permitted to attend the lectures who in *propria forma* have been admitted as students.

§ 22. All subjects of instruction are obligatory.

§ 23. Students who desire to attend lectures not belonging to their division, must have a special permit.

§ 24. The teachers must, by frequent catechising, satisfy themselves that the students thoroughly understood all that has been taught.

§ 25. The more advanced students shall have an opportunity of visiting important machine-shops and industrial establishments.

§ 26. For the furtherance of scientific zeal, prizes will be given for the best solution of certain set problems.

§ 27. Opportunity shall be given to pass in each of the three divisions, theoretical and practical examinations.

§ 28. Students must pay an annual lecture-fee not to exceed seven francs, for the weekly hour of the annual course.

§ 29. The admission and examination fees will be settled by a future regulation.

§ 30. Young Swiss, who from their own cantons, receive stipends for their education as civil engineers, industrial mechanics or industrial chemists, must be obliged, by their cantonal government, to attend the Federal Polytechnic School.

§ 31. Talented young Swiss citizens, who wish to follow the courses at the Federal Polytechnic School, but who neither have the means themselves nor can obtain them from their own cantons, shall as far as possible, be aided by stipends from the Federal government.

§ 32. Poor but talented students of the Federal Polytechnic School may, whether they draw stipends or not, be freed from paying the lecture-fees.

## III. THE TEACHERS.

§ 33. All teachers at the Federal Polytechnic School must be formally installed and draw a regular salary.

§ 34. They are either professors or assistants.

§ 35. Professors have an independent sphere of activity, assistants only a subordinate one.

§ 36. The professors are either ordinary or extraordinary.

§ 37. Ordinary professors have a larger salary, and perform more duties.

§ 38. Professors are appointed for life.



§ 39. The total annual expenses for salaries are not to exceed the sum of forty-six thousand francs.

§ 40. The school-fees are divided among the professors, according to the number of lectures held by each.

§ 41. A fund is instituted, from which pensions are paid to superannuated professors, to professors' widows and orphans. Pensions or indemnifications to professors who have been removed, are paid from the Federal treasury.

§ 42. The pension fund is maintained by a certain per centage of the school-fees, and if necessary, by a per centage on the professors salaries, the latter not to exceed one per cent.

#### IV. THE TEACHERS' CONFERENCE.

§ 43. All the professors of the Federal Polytechnic School form the teachers' conference.

§ 44. The Rector of the Polytechnic School is president of the conference.

§ 45. The Rector is chosen from among the professors for the period of one year.

§ 46. The teachers' conference must superintend the scientific life of the institution in general and in particulars, and watch the moral character and diligence of the pupils.

§ 47. As regards the subjects mentioned in the preceding paragraph, the teachers' conference must make an annual report to the Federal Government. Besides this the teachers' conference is intrusted with the immediate maintenance of discipline among the students.

§ 48. The teachers' conference must decide in cases of pupils wishing to attend lectures not strictly belonging to their division.

§ 49. The teachers' conference must criticise the prize essays, &c.

§ 50. The teachers' conference decides at the end of the annual course, which pupils ought to advance to higher courses.

§ 51. The teachers' conference arranges and superintends the various examinations.

§ 52. The essential duty of the Rector is to direct and superintend the business of the teachers' meeting.

#### V. THE FEDERAL COUNCIL, AND SCHOOL COUNCIL.

§ 53. The Swiss Federal Council is the supreme authority of the Federal Polytechnic School.

§ 54. Its resolutions regarding the Federal Polytechnic School are taken on motion of the Department of the Interior.

§ 55. Immediately after the Federal Council in the superintendence of the school comes the School Council.

§ 56. The School Council consists of a president and two members. They are chosen by the Federal Council from among all Swiss citizens who are voters. In this Council there are never to be two or more citizens of one and the same canton at the same time. The president is not allowed to have any other office, nor to have any business carried on on his account.

§ 57. The official term of the School Council is three years. Immediately after every new election for the Federal Council, the School Council is also elected anew.

§ 58. The School Council holds its sessions in the city, where the Polytechnic School is located.

§ 59. Its meetings are called by the President as often as there is any business on hand. The President must call a meeting of the School Council whenever the Federal Council, or two other members demand it.

§ 60. The President must live in the city where the Federal Polytechnic School is located.

§ 61. The President has a salary of five thousand francs: the members of the School Council receive a remuneration for each day they are in session, and mileage.

§ 62. The secretariate of the School Council will be arranged by the Federal Council.

§ 63. The Federal Council has likewise to regulate the management of the school treasury, the pension fund, &c.



§ 64. In important cases the Federal Council will decide after consulting the School Council, and if desirable, the teachers' conferences.

§ 65. Important regulations are promulgated by the Federal Council, those less important by the School Council.

§ 66. The professors and assistants are appointed by the School Council, and their salaries fixed by the same body, with the approval of the Federal Council.

§ 67. The Federal Council alone accepts the resignation of professors and assistants.

§ 68. The Federal Council may retire a professor or assistant on account of age or sickness, with at least half of his former salary as pension.

§ 69. If a professor or assistant has been guilty of such dereliction of duty as makes his removal from office desirable, he is to be removed on motion of the School Council by the Federal Council without a pension. He may, however, sue for an indemnification in the Federal courts of justice.

§ 70. Further regulations will be made defining the powers of the Federal Council and the School Council, as to the school funds.

§ 71. The Federal Council submits to the Federal Assembly, on motion of the School Council, the annual estimates for the Federal Polytechnic School, as part of the budget for the whole republic.

§ 72. The Federal Council decides, on motion of the School Council, on all the annual bills of the Federal Polytechnic School.

§ 73. The Federal Council, on motion of the School Council, decides on the acceptance of donations or legacies made to the Polytechnic School for special purposes.

§ 74. The School Council decides on the distribution of the Federal stipends, the exemption from school and other fees.

§ 75. The School Council remits to the Federal Council an annual report on the condition of the Federal Polytechnic School and for this purpose receives the necessary information from the teachers' conference.

§ 76. The President of the School Council has to present a motion for dispatching the business placed before the Council.

§ 77. In the absence of both members, the President carries on all current business.

#### THE LOCATION OF THE FEDERAL POLYTECHNIC SCHOOL.

§ 78. The canton and city where the Federal Polytechnic School is located, must,—1. Place all scientific collections at the free disposal of the Federal Polytechnic School. 2. See that such collections as may be the property of corporations are fully made available to the Federal Polytechnic School. 3. Provide the buildings required for the School Council, the teachers' conference, school festivals, lectures, laboratories, workshops, library, museum, servants of the school, and for gymnastic exercises. 4. Pay an annual sum of sixteen thousand francs towards the expenses of the Federal Polytechnic School, in quarterly installments. This annual contribution diminishes from the time when the interest of the Polytechnic School fund can be used for the benefit of the school, by one-fifth of the amount of interest of that fund.

§ 79. The officers, teachers and servants of the Federal Polytechnic School, in their relation to the laws and authorities of the canton in which the school is located, are to be treated exactly as all other Federal officers and officials.

§ 80. The students of the Federal Polytechnic School are subject to the general penal police and civil laws of the canton, in which the school is located. For transgression of all special regulations made by the authorities of the school, the students are punished by such authorities exclusively.

#### TEMPORARY REGULATIONS.

§ 81. In designating the canton and city within which the Federal Polytechnic School is to be located, the same course is to be followed as in the location of the Federal capital.

§ 82. Two months from the date when the offer is made, the authorities of the respective canton or city shall return their answer to the Federal Council.

§ 83. This law goes into operation from the date of its passage. The Federal Council is to take the necessary measures for carrying it into effect.



## GOVERNMENT OF THE TECHNICAL UNIVERSITY.

## A. SWISS SCHOOL-COUNCIL.

<i>President</i> , .....	Mons. C. Kappeler.
<i>Vice-President</i> , .....	Dr. A. Escher.
<i>Members</i> , {	..... Professor Dr. Bern. Studer.
	..... Councilor Aug. Keller.
	..... Professor Pictet de la Rive.
<i>Deputies</i> , {	..... Director Aimé Humbert.
	..... Councilor A. V. Planta.
<i>Secretary</i> , .....	..... Choirmaster Jos. Ghiringhelli.
	..... Mons. J. G. Baumann.

## B. COMMITTEE.

<i>Director</i> , .....	Mons. E. Landolt.
<i>Deputy</i> , .....	Dr. Gustavus Zenner.
<i>Secretary of Committee</i> , .....	Mons. J. Rudolf.

The teaching of the Polytechnic School is the work of 57 teachers, of whom 31 are regular professors, 10 assistant-professors, and 16 private teachers and lecturers.

Each of these gives several courses of lectures or of private instruction, and the whole number of subjects taught or courses of lectures this year (1868) is 145, exclusive of a large number of additional or extra subjects, which do not form essential parts of the regular curriculum of instruction. These 145 subjects of instruction are comprehended in the following list:

## PROFESSORSHIPS AND COURSES OF INSTRUCTION.

- PROF. ARDUINI. 1. Storia comparata della lingua e dei dialetti Italiani. 2. Scrittori d'arte e artisti, il Cellini et il Vasari. 3. Il Machiavelli. 4. Esercizi varg. di lingua.
- PROF. DR. BEHN-ESCHENBURG. 5. The English historians. 6. Shakspeare's "King Lear," translated and explained. 7. English exercises and grammar.
- PROF. DR. BOHMERT. 8. General economy. 9. Finance. 10. Lectures and discussions on political economy.
- PROF. DR. BOLLEY. 11. Technical chemical practice. 12. Bleaching, printing, and dyeing. 13. Manufacture of chemical products. 14. Glass and pottery.
- PROF. DR. CHERBULIEZ. 15. Political economy. 16. International law. 17. Free trade, exchange, and protective duties.
- PROF. DR. CHRISTOFFEL. 18. Differential and integral calculus. 18 *a*. Examinations. 19. Theory of equations. 19 *a*. Examinations.
- PROF. DR. CRAMER. 20. Elements of botany. 21. Universal botany. 22. Microscopic observations.
- PROF. CULMANN. 23. Earth-works, stone bridges, and tunnels. 23 *a*. Repetition. 24. Practical construction. 25. Roads and canals.
- PROF. DUFRAISSE. 26. Droit civil. 27. Droit administratif. 28. Droit forestier. 29. Droit commercial.
- DR. EGLI (private tutor.) 30. Physical geography, (inorganic.) 31. Examinations. 32. Drawing for historical, geographical, and economic studies. 33. History of geology. 34. Geographical phenomena; Abyssinia, Gulf-stream, Nile, Canal of Suez, &c. 35. Palestine—geographically and archæologically.
- PROF. ESCHER V. D. LINTH. 36. General geology. 37. Technical geology.
- DR. FEHR (private tutor.) 38. Exposition of sculpture in the archæological museum.
- PROF. DR. FIEDLER. 39. Representative geometry, with examinations. 39 *a*. Exercises in two groups, each one hour. 40. Plane geometry. 41. Elements of the theory of determinate and rectangular coördinates. 42. Geometry of curves of the third order.
- PROF. DR. FREY. 43. Zoölogy. 43 *a*. Examination.

- MR. FRITZ (private tutor.) 44. Technical drawing (preparatory course.) 45. Technical drawing (first and second course of the chemical technical division.) 46. Elements of machinery. 47. Machine-drawing. 48. Lectures on machine-construction.
- DR. GEISER (private tutor.) 49. Introduction to synthetic geometry. 50. Selections from the higher parts of geometry.
- PROF. GLADBACH. 51. Construction of buildings. 52. Plan-drawing. 53. Engineering plan-drawing.
- MR. HARLACHER (private tutor.) 54. Theory and construction of girders. 55. Manufacture of wrought-iron and cast-iron girders.
- PROF. DR. HEER. 56. Pharmaceutical botany. 57. The plants of geology. 58. On fossil insects.
- MR. HUG (private tutor.) 59. Differential and integral calculus.
- PROF. KEISER. 60. Practice in modeling ornaments, and in stone-carving.
- PROF. KELLER. 61. German language.
- PROF. DR. KENNGOTT. 62. Mineralogy. 62 *a*. Examination. 63. Characters of minerals. 64. Museum of mineralogy.
- DR. KINKEL. 65. History of ancient art, from Egypt to Pompeii. 66. History of renaissance art (architecture and sculpture.)
- PROF. KOPP. 67. Encyclopedia of forestry. 68. Theory of climates. 68 *a*. Examination. 69. Excursions and practical experiments.
- PROF. KRONAUER. 70. Mechanical technology (spinning, weaving, paper-making, &c.)
- PROF. DR. KUNDT. 71. Technical physics. 71 *a*. Examination. 72. Theory of light. 73. Experimental physics.
- MR. KUNZLER (private tutor.) 74. Mechanics. 75. Differential calculus. 76. Technical mechanics.
- PROF. LANDOLT. 77. Theory of forestry. 78. Foresters' duties. 79. Forestry (trade.) 79 *a*. Examinations. 80. Excursions and practical applications.
- PROF. LASIUS. 81. Construction of buildings (second course.) 82. Construction of buildings (third course.) 83. Plan-drawing and perspective (second course.)
- PROF. LUDEWIG. 84. Construction of machinery. 84 *a*. Examination. 85. Chapters from the history of mechanical construction, with practical examples, &c.
- DR. MAYER (private tutor.) 86. Paleontology.
- PROF. MEQUET. 87. Differential and integral calculus (pupils of the first year.) 87 *a*. Examination. 88. Differential and integral calculus (pupils of the second year.)
- DR. MERZ (private tutor.) 89. Pharmaceutical chemistry. 90. Examination in inorganic chemistry. 91. On scents and perfumes. 92. On alcohols.
- M. MOSCH (private tutor.) 93. Geology of Switzerland, with regard to its influence on trade, &c. (gratis.)
- PROF. DR. MOUSSON. 94. Experimental physics; first half. 94 *a*. Examination in French. 94 *b*. Examination in German. 95. Chemical physics. 95 *a*. Examination.
- PROF. ORELLI. 96. Differential and integral calculus (school of architecture, first course.) 97. Mathematics (preliminary course,) algebra, geometry, &c. 97 *a*. Exercises. 97 *b*. Examination.
- PROF. PESTALOZZI. 98. Construction of streets and canals. 99. Practical geometry (in German and French.)
- DR. PICCARD (private tutor.) 100. Inorganic and experimental chemistry. 100 *a*. Examination in groups. 101. Toxicology. 102. Pharmaceutical chemistry.
- PROF. DR. PRYM. 103. Analytical geometry of the plane, with exercises. 104. Introduction to the theory of functions.
- PROF. RAMBERT. 105. Histoire littéraire, Corneille et Racine. 106. Exercices supérieurs, pour les élèves français. 107. Exercices supérieurs, pour les élèves allemands. 108. Exercices élémentaires. 109. Langue française (preliminary course.)
- PROF. DR. REYE. 110. Introduction to the theory of numbers. 111. Analytical mechanics.



- PROF. DR. RUTTIMANN. 112. Swiss federal constitution and rights.  
 PROF. DR. SCHERR. 113. Twelve literary world-known characters--Homer, Æschylus, &c. &c. 114. Lessing, Goethe, Schiller, their lives, works, and companions. 115. History of the nineteenth century.  
 PROF. DR. SEMPER. 116. Comparison of styles. 117. Designing.  
 DR. V. SECKENDORFF (private tutor.) 118. Taxes and revenues of woods and forests.  
 MR. STADLER (teacher.) 119. Ornamental drawing, decoration, color, &c. 120. Decoration of private and public buildings.  
 PROF. DR. STADLER. 121. Experimental chemistry. 121 *a*. Examination. 122. Selections from chapters on chemistry. 123. Practical chemical experiments.  
 PROF. STOCKER. 124. Geometry of space, algebra, trigonometry. 124 *a*. Exercises. 125. Mathematics of forestry.  
 MR. STUTZ (private tutor.) 126. History of the creation, with regard to the Bible.  
 PROF. ULRICH. 127. Landscape-drawing, in pencil, sepia, and water-colors.  
 PROF. VEITH. 128. Pumps, turbines, and water-wheels. 129. Construction of machinery.  
 PROF. VOGELI. 130. History of Switzerland, 1474-1515.  
 DR. WEITH (private tutor.) 131. History of chemistry. 132. Review of inorganic chemistry according to modern principles. 133. Groups of Cynans. 134. Chemistry of animal bases and acids.  
 MR. WERDMULLER. 135. Figure-drawing.  
 PROF. WILD. 136. Topography. 137. Geodesy. 138. Plan-drawing. 139. Map-drawing.  
 PROF. DR. WOLF. 140. Astronomy. 140 *a*. Examination (for the engineering division.) 140 *b*. Examination (for pupils of the sixth division.) 141. Elements of astronomy.  
 MR. WOLFENSPERGER (musical director.) 142. Harmony.  
 PROF. DR. ZEUNER. 143. Technical mechanics. 143 *a*. Examination in groups. 144. Theoretical mechanics (heat and steam--steam-engines.) 145. Theory of insurance (calculations of probability and mathematical statistics.)

In addition to these, there are assistants.

In running one's eye over this large list of teachers and subjects to be taught, the eye of the English parent or guardian would find itself hopelessly overwhelmed with *embarras de richesses*. But such a contingency has been foreseen, and admirably provided for, even without encroaching on that perfect liberty of the individual of which we English think and talk so much. The student of the Polytechnicum is at perfect liberty to attend what courses he pleases, and to neglect all he does not like. He may go to the Polytechnicum either for business or pleasure; either to qualify himself for some special duty in life, or to study things in general, and thus far our notions of liberty are here realized. But in this free manner of study comparatively few students enter themselves. Out of the whole number of 762, only 173 are free students--the remaining 589 prefer to study, according to rule and method, for some specific aim in life.

There is an organized curriculum, prepared by the governors and the professors, which affords the parent or the pupil all the best advice of matured wisdom as to the course of study which the student should pursue during the three years of his university career. These studies are parceled out over a period of three years, and each year is divided into two courses--the summer and winter half-year. The student is further assisted by being told what are the subjects with which he should be acquainted before entering the university, so as best to avail himself of its advantages; and there is this further kindly provision made for him, that if he is unfortunate enough to have been badly prepared in any of the essential points of preliminary study, a special series of preparatory studies are provided as an aid to make good his defects and bring him up to the level of better-prepared pupils.

In addition to its vast living organization of professors, masters and tutors, the Zurich Polytechnicum is rich in the apparatus of instruction, viz., in a large astronomical observatory, a chemical and mechanical laboratory for practical work, a chemical laboratory of professional teaching, a collection of models,



drawings, &c., for architectural and mechanical illustrations, a botanical garden, cabinet of geology, zoölogy, &c. &c.

EXPENSE OF TECHNICAL EDUCATION IN SWITZERLAND.

In conclusion we have only to say what this vast engine for the improvement of the Swiss people costs the Confederation. The Englishman who studies these figures should remember that it is the provision made for a population of only 2,500,000; for the most part only agricultural peasants, inhabiting a mountainous and comparatively sterile country. In measuring the expense we should also bear in mind that francs go as far in Zurich as crowns in London.

To the foundation of the Polytechnical University the Federal Government contributed 20,000*l.*, and the Canton of Zurich 136,000*l.* The annual expenses and contributions of the students are:

*Income.*

1. Loan from the State treasury,.....	£10,000
2. Loan from the Canton of Zurich,.....	640
3. Pupils' fees,.....	2,653
4. Loan from the Canton and State of Zurich for collections and museums,.....	166
	<hr/>
Total income,.....	£13,459

*Expenses.*

1. Government of the University,.....	£1,680
2. Salaries of professors and teachers,.....	9,500
3. Collections and museums,.....	2,146
4. Prizes,.....	40
5. Furniture, &c.,.....	93
	<hr/>
Total expenses,.....	£13,459

Such is our model university; and I ought not to leave it without testifying to its perfect success. My first acquaintance with this university arose out of the incident of a young relation of my own happening to desire to obtain an education in a branch of civil engineering, and finding it impossible to obtain that education in England. Fortunately for him, an Englishman of science, well acquainted with foreign education, recommended to him the technical university of Zurich. He went there; he passed through its courses; returned to England; entered himself in the usual manner as a learner in the works of an eminent engineer. Here the advantages of Zurich soon showed themselves unmistakably; his superiority was so evident that he soon rose over the heads of much older men, and long before his apprenticeship expired, he had already been intrusted with heavy responsibilities and important duties, which could not be intrusted to men much older and more experienced, but less skillfully trained, and less highly educated. This youth was a standing example of the practical excellence of Zurich. This was the incident which afterwards induced me to study carefully the organization of that institution, with the determination to do my best towards obtaining for young Englishmen equal privileges in their own country; and I may say that the result of a practical acquaintance with that institution, and of personal intimacy with many of those who have been its pupils, is to satisfy me that this Swiss university is a noble proof of the wisdom of her patriots and statesmen—of the enlightened generosity of the countrymen and citizens of Zurich; and that the institution they have founded is, in its aim, its organization, and its practical effect, well worthy of the study and the rivalry of any statesmen and any citizens who do not believe their countrymen unworthy of high intellectual cultivation, and sound technical training for life.

We append the latest Programme of Subjects of Instruction, arranged in eight schools or divisions, together with a brief description of the building erected by the Canton of Zurich for the accommodation of the Polytechnicum.



# SWISS FEDERAL POLYTECHNIC SCHOOL, ZÜRICH.

PROGRAMME FOR 1856-7, ESPECIALLY THE FIRST HALF-YEAR.

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## SUBJECTS OF INSTRUCTION, CLASSED BY DIVISIONS.

### FIRST DIVISION, OR SCHOOL OF ARCHITECTURE.

*First Year.*—1. *a.* Art of building, 3 hours; Thursday, Friday and Saturday, 10 to 11.

*b.* Architectural design and exercises on building, 3 afternoons, (6 hours per week in winter, 9 in summer;) Wednesday, Friday and Saturday, 2 to 4.

2. Mechanics, 6 hours; Monday, Wednesday and Saturday, 2 to 4.

3. *a.* Elements of differential and integral calculus, 4 hours; Tuesday and Thursday, 8 to 10.

*b.* Exercises on differential and integral calculus, 2 hours; Friday, 8 to 10.

4. *a.* Stone-cutting; and as introductory, theory of contacts and intersections of curved surfaces, 3 hours; Tuesday and Friday, 5 to 6; Saturday 6 to 7.

*b.* Drilling and exercises on stone-cutting, 1 hour; not yet determined.

5. Designing the figure, (5 hours in winter, 9 summer;) Monday, Tuesday and Thursday, 2 to 4, or 5.

6. Modeling in earth or plaster, 3 hours; Monday, 1 to 4.

In all, 16 hours of lessons; 16 to 22 hours of exercises.

*Second Year.*—1. Art of building civil edifices (continuation of course of construction,) 3 hours; Wednesday, Friday and Saturday, 11 to 12.

2. Art of building in middle ages and in the *Renaissance*. (During the second half-year, modern art of building,) 4 hours; Tuesday and Friday, 5 to 7.

3. Architectural design, sketches and detailed drawings of plans of buildings, (6 to 9 hours;) Tuesday, Friday and Saturday, 2 to 4.

4. *a.* Perspective and theory of shadows, 2 hours; Monday and Wednesday, 6 to 7.

*b.* Exercises on the same, 1 hour; not yet fixed.

5. Construction of roads and bridges, 3 hours; Tuesday and Wednesday, 8 to 9, and another hour not determined.

6. Theory of machines, 4 hours; Tuesday and Friday, 8 to 10.

7. Designing the figure, 2 or 3 hours; Monday, 2 to 4 or 5.

8. Modeling in earth or plaster, 2 to 3 hours; Saturday, 2 to 4 or 5.

In all, 15 hours of lessons; and 11 to 16 of exercises.

*Third Year.*—1. Art of building in the middle ages and during the *Renaissance*. (In the second half-year, modern art of building,) 4 hours; Tuesday and Friday, 3 to 7.

2. Drafting and detail drawings of architectural plans, 4 afternoons; Tuesday, Wednesday, Friday and Saturday, 2 to 4.

3. History of the *Renaissance*, 4 hours; Monday, Wednesday, Friday and Saturday, 5 to 6.

4. Designing the figure, 1 afternoon, 2 or 3 hours; Monday, 2 to 4 or 5.

5. *a.* Geology, 4 hours; Tuesday, Thursday, Friday and Saturday, 9 to 10.

*b.* Drilling on geology, 1 hour; not yet fixed.

In all, 12 hours of lessons, and at least 3 afternoons of exercises.

### SECOND DIVISION, OR SCHOOL OF CIVIL ENGINEERING.

*First Year.*—1. Topography, 3 hours; Monday, Tuesday and Thursday, 10 to 11.

2. Designing plans, 2 or 3 hours; Monday, 2 to 4 or 5.
3. Elements of astronomy (for the first half-year,) 3 hours; Wednesday Thursday and Saturday, 5 to 6; (Obligatory only upon pupils devoting themselves to the study of geodesy.)
4. *a.* Art of building, 3 hours; Wednesday, Friday and Saturday, 2 to 4.  
*b.* Designs for building, 2 afternoons, Tuesday and Thursday, 2 to 4; (4 hours in summer, 6 in winter.)  
(These two items are obligatory only upon pupils devoting themselves to civil engineering proper, as roads, railroads, &c.)
5. Mechanics, 6 hours; Monday, Wednesday and Saturday, 8 to 10.
6. Designing machines, 1 afternoon; Friday, 2 to 4; (2 hours in winter 3 in summer.)
7. *a.* Elements of differential and integral calculus, 4 hours; Tuesday and Monday, 8 to 10.  
*b.* Exercises on the same, 2 hours; Friday, 8 to 10.
8. *a.* Stone-cutting, and as introductory, theory of contact and intersection of curved surfaces, 3 hours; Tuesday and Friday, 5 to 6; Saturday, 6 to 7.  
*b.* Drilling and exercises in the art of stone-cutting, 1 hour; not yet fixed.
9. Land-measuring, (in summer,) one day.  
19 hours of lessons; 7 to 13 hours of exercises; and in summer, one day of Land-measuring.

*Second Year.*—1. *a.* Construction of roads, railroads and hydraulic buildings, 3 hours; Monday, Tuesday and Thursday, 11 to 12.

*b.* Drilling in the same, 1 hour; Wednesday, 9 to 10.

2. Exercises in construction of roads and hydraulic works, 3 afternoons, (6 hours in winter, and 9 in summer;) Monday, Tuesday, and Wednesday, 2 to 4 or 5.

(Obligatory only on pupils devoting themselves to civil engineering.)

3. Geodesy, 2 hours; Tuesday and Wednesday, 8 to 9. (Obligatory only on pupils devoting themselves to geodesy.)

4. Drawing maps, 3 hours; Thursday, 2 to 4 or 5.

5. Theory of machines, 4 hours; Tuesday and Wednesday, 8 to 10.

6. Setting up of machines, 1 afternoon, (2 hours in winter, 3 in summer;) Friday, 2 to 4.

7. *a.* Integral calculus, 2 hours; Monday and Friday, 10 to 11.

*b.* Analytical geometry, 2 hours; Friday and Saturday, 10 to 11.

*c.* Exercises in integral calculus and analytical geometry, 2 hours; Tuesday and Thursday, 10 to 11.

*d.* Integral calculus (a second course,) 3 hours; Monday and Friday, 10 to 11; and one hour not yet fixed.

(*b.* and *c.*, above, obligatory upon all pupils, and either *a* or *d*, at their option.)

8. *a.* Perspective, and theory of shadows, 2 hours; Monday and Friday, 6 to 7.

*b.* Exercises on the same, 1 hour; not yet fixed.

9. Industrial physics, Industrial natural philosophy, 4 hours; Monday and Thursday, 8 to 10.

10. Modeling in earth and in plaster, 1 afternoon, 3 hours; Saturday, 1 to 5.

11. Technology of building materials, 1 hour; Monday, 4 to 5

(In winter,) 13 to 21 hours of lessons; 12 to 19 hours of exercises.

*Third Year.*—1. *a.* Construction of roads; hydraulic building, 3 hours; Monday, Tuesday and Friday, 10 to 11.

*b.* Drilling on the same, 1 hour; Thursday, 10 to 11.

2. Exercises on the same, 3 afternoons; Monday, Tuesday and Wednesday, 2 to 4 or 5.

3. Geodesy, 2 hours; Tuesday and Wednesday, 8 to 9.

4. Drawing maps, 3 hours; Thursday, 2 to 4 or 5.

5. *a.* Geology, 4 hours; Tuesday, Thursday, Friday and Saturday, 9 to 10.

*b.* Drilling on same, 1 hour; not yet fixed.

Lessons, 9 hours; exercises, all remaining hours.



THIRD DIVISION, OR SCHOOL OF INDUSTRIAL MECHANICS.

*First Year.*—1. Mechanics, 6 hours; Monday, Tuesday, Wednesday, 8 to 10.

2. Designing machines, 2 afternoons; (4 hours in winter, 6 in summer;) Wednesday and Saturday, 2 to 4 or 5.

3. *a.* Elements of differential and integral calculus, 4 hours; Tuesday and Thursday, 8 to 10.

*b.* Exercises on same, 2 hours; Friday, 8 to 10.

4. *a.* Stone-cutting; and as introductory, theory of contact and intersection of curved surfaces, 3 hours; Tuesday and Friday, 5 to 6; Saturday, 6 to 7.

*b.* Drill and exercises on same, 1 hour; not yet fixed.

5. Construction of models in metal, 1 afternoon, 3 hours; Friday, 1 to 4.

6. Construction of models in wood, 1 afternoon, 3 hours; Tuesday, 1 to 4.

Lessons, 13 hours; exercises, 13 to 15 hours.

*Second Year.*—1. Theory of machines, 2 hours; Tuesday and Friday, 8 to 10.

2. *a.* Construction of machines, 4 hours; Wednesday and Saturday, 8 to 10.

*b.* Setting up of machines, 4 afternoons, (8 hours in winter, 12 in summer;) Tuesday, Wednesday, Thursday and Saturday, 2 to 4 or 5.

3. *a.* Integral calculus, 2 hours; Monday and Wednesday, 10 to 11.

*b.* Analytic geometry, 2 hours; Friday and Saturday, 10 to 11.

*c.* Exercises on both the above, 2 hours; Tuesday and Thursday, 10 to 11.

*d.* Integral calculus (a second course,) 3 hours; Monday and Wednesday 10 to 11; 1 hour not yet fixed.

(*b* and *c.*, above, obligatory on all pupils; and either *a* or *d.*, at their option.)

4. Construction of models in metal, 1 afternoon, 3 hours; Monday, 1 to 4.

5. Industrial physics, 4 hours; Monday and Thursday, 8 to 10.

6. Mechanical technology, (in winter,) 4 hours; Monday and Friday, 11 to 12; Saturday, 11 to 12 and 4 to 5.

FOURTH DIVISION, OR SCHOOL OF INDUSTRIAL CHEMISTRY.

*First Year.*—1. Inorganic chemistry, 5 hours; Monday to Friday, 10 to 11.

2. Exercises on classical analysis in the laboratory, 2 afternoons, 6 hours; Monday and Tuesday, 1 to 4.

3. *a.* Zoölogy, first part, 5 hours; Monday to Friday, 5 to 6.

*b.* Drill on same, 1 hour; not yet fixed.

4. General botany, 3 hours; Monday to Friday, 4 to 5.

5. Mineralogy, 2 to 3 hours; Wednesday and Friday, 3 to 4.

6. Technical designing, 4 hours; Monday, 8 to 10; Saturday, 10 to 12.

Lessons, 13 hours; exercises, at least 11 hours.

*Second Year.*—*a. Division of Industrial Chemistry.*—1. Industrial chemistry, 4 hours; Monday to Thursday, 10 to 11.

2. Manipulations in the laboratory of industrial and pharmaceutical chemistry, 4 afternoons, 12 hours; Monday to Thursday, 1 to 4.

3. Industrial physics, 4 hours; Monday and Thursday, 8 to 10.

4. Technical designing, 4 hours; Tuesday and Saturday, 10 to 12.

5. Chemical technology of building materials, 1 hour; Monday, 4 to 5.

6. *a.* Geology, 4 hours; Tuesday, Thursday, Friday and Saturday, 9 to 10.

*b.* Drill on same, 1 hour; not yet fixed.

Lessons 13 hours; exercises 17 hours.

*b. Division of Pharmaceutical Chemistry.*—1. Industrial chemistry, 4 hours; Monday to Thursday, 10 to 11.

2. Manipulations in laboratory of industrial and pharmaceutical chemistry, 4 afternoons, 12 hours; Monday to Thursday, 1 to 4.

3. Technical portion of pharmacy, 2 hours; Tuesday and Thursday, 4 to 5.

4. Raw materials, pharmaceutically considered, 3 hours.

5. Pharmaceutical botany, 3 hours; Thursday, Friday and Saturday, 3 to 4.

6. Industrial physics, 4 hours; Monday and Thursday, 8 to 10.

Lessons, 16 hours; exercises, 12 hours.

## FIFTH DIVISION, OR SCHOOL OF FORESTRY.

*First Year.*—1. Encyclopedia of forestry, 3 hours; Monday, Wednesday and Thursday, 8 to 9.

2. Valuation and estimates of roads, 2 hours; Monday and Wednesday, 9 to 10.

3. Excursions, exercises on taxation, drill and conversation, 1 day; Saturday.

4. *a.* Zoölogy, first part, 5 hours; Monday to Friday, 5 to 6.

*b.* Drill and questions on above, 1 hour; not yet fixed.

5. General botany, 3 hours; Monday to Friday, 4 to 5.

6. Mineralogy, 2 hours; Wednesday and Friday, 3 to 4.

7. Topography, 3 hours; Monday, Tuesday and Thursday, 10 to 11.

8. Design of plans, 2 to 3 hours; Monday, 2 to 4 or 5.

9. Geology, with drill on same, 5 hours; Tuesday, Thursday, Friday and Saturday; and 1 hour not yet fixed.

Lessons, 24 hours; exercises, 4 to 5 hours, and 1 day.

*Second Year.*—1. Forest administration and police, 3 hours; Monday, Wednesday, Friday, 11 to 12.

2. Preservation of forests, 2 hours; Tuesday and Thursday, 11 to 12.

3. Statistics and literature of forestry, 1 hour; Friday, 10 to 11.

4. Management of forests, 4 hours; Tuesday and Friday, 8 to 10.

5. Introduction to management of forestry business, 1 hour; Monday, 6 to 7.

6. Excursions, drill, and conversation, 1 day; Saturday.

7. Construction of bridges and roads, 2 hours; Wednesday, 8 to 9; and 1 hour not yet fixed.

8. Industrial physics, 4 hours; Monday and Thursday, 8 to 10.

Lessons, 11 hours; exercises, 1 day and 1 hour.

## SIXTH DIVISION; OF PHILOSOPHICAL AND POLITICAL SCIENCE.

*a. Natural Sciences.*—1. Inorganic chemistry, 3 hours; Monday to Friday, 10 to 11.

2. Exercises on chemical analysis in laboratory, 3 hours; Tuesday, 1 to 4.

3. Exercises, for the most advanced students, every day except Saturday.

4. Chemical technology of building materials, 1 hour; Monday, 4 to 5.

5. Experimental physics, 6 hours; every day, 11 to 12.

6. Drill on the preceding, 2 hours; not yet fixed.

7. Mathematical physics; introduction, and theory of elasticity, 4 hours; Tuesday, Wednesday, Friday and Saturday, 8 to 9.

8. Zoölogy, first part, 3 hours; Monday to Friday, 5 to 6.

9. Drill and questions on same, 1 hour; not yet fixed.

10. General botany, 5 hours; Monday to Friday, 4 to 5.

11. Use of microscope, daily; forenoon.

12. Antediluvian plants, 3 hours; Monday, Tuesday and Friday, 2 to 3.

13. Fossil insects, 2 hours; Tuesday and Wednesday 5 to 6.

14. Natural history of mushrooms, with special reference to maladies of plants and animals, 2 hours.

15. Drill on general botany, with microscopic demonstration, 2 hours.

16. Drill on general botany, with herbal, 1 hour.

17. Geology, 4 hours; Tuesday, Thursday, Friday and Saturday, 9 to 10.

18. Drill on same; 1 hour, not yet fixed.

19. Swiss materials for building, 2 hours; Tuesday and Thursday, 4 to 5.

20. History, construction and coloring of geological charts and sections.

21. Mineralogy, 2 to 3 hours; Wednesday and Friday, 3 to 4.

(Other lessons on mineralogy will be hereafter announced.)

*b. Mathematical Sciences.*—22. Integral calculus, continued from last term, for second year of second and third divisions, 2 hours; Monday and Wednesday, 10 to 11.

23. Analytical geometry, continued from last term, for second year of second and third divisions, 2 hours; Friday and Saturday, 10 to 11.

24. Exercises for all the students of first and second year of second and third divisions, 2 hours; Tuesday and Thursday, 10 to 11.



25. Algebraic analysis, 2 hours; Monday and Thursday, 11 to 12.
26. Elements of differential and integral calculus, 4 hours; Tuesday and Thursday, 8 to 10.
27. Exercises on differential and integral calculus, 2 hours; Friday, 8 to 10.
28. Intersection and contact of curved surfaces, and stone-cutting, 4 hours; Tuesday and Friday, 5 to 6; Saturday, 6 to 7; and 1 hour not yet fixed.
29. Perspective and theory of shadows, 3 hours; Monday and Wednesday, 6 to 7; and 1 hour not yet fixed.
30. Elements of astronomy, as introduction to geodesy, 3 hours; Wednesday, Thursday and Saturday, 5 to 6.
31. Mathematics, pure and applied, after a manual to appear soon, 4 hours; and a drill of 1 hour.
32. Practical course of differential and integral calculus, 3 hours.
33. Descriptive geometry, first part, 2 to 3 hours.
34. Method of teaching mathematics for candidates for employment as teachers, 2 hours.
35. Geometrical analysis of surfaces of the second degree, 2 hours.
36. Synthetic geometry, after Steiner, 2 hours.
37. Theoretical astronomy, 2 hours.
38. Integral calculus, 3 hours; Monday and Wednesday, 10 to 11; and 1 hour not yet fixed.
39. Elementary mathematics, including the branches detailed in the programme for 1856-7, (in French,) 6 hours.
40. Political arithmetic, (interest, rent, savings' banks, banks,) &c., 2 hours; (in German or French.)
41. Mechanics, 6 hours; Monday, Wednesday and Saturday, 8 to 10.
- c. Literary, Moral and Political Science.*—42. "Faust" of Goethe, 2 hours; Wednesday and Friday, 4 to 5.
43. "Parcival" of Wolfram von Escheuback and "Tristan" of Gottfried von Strassburg, 2 to 3 hours; Tuesday, Thursday and Saturday, 4 to 5.
- (The same instructor, (Prof. Vischer,) will give a course of instruction at the university, in æsthetics, part first, 4 to 5 hours.)
44. French literature, 3 hours; Tuesday, Thursday and Saturday, 4 to 5.
45. Italian literature, 3 hours; Tuesday, Thursday, Friday, 6 to 7.
46. Italian composition, 1 hour; Thursday, 5 to 6.
47. History of English literature from end of last century to present time, 2 hours; Tuesday and Thursday, 6 to 7.
48. Shakspeare's "Timon of Athens," and "Love's Labors Lost," translated and explained, 2 hours; Monday and Wednesday, 6 to 7.
49. Exercises in speaking and writing English, 2 hours; Monday, 5 to 6; and Friday, 6 to 7.
50. General modern history, with special reference to intellectual developments, 3 hours; Monday to Friday.
51. Sources of Roman History, 2 hours; Saturday, 9 to 11.
52. Art of building in the middle ages and the *Renaissance*; and as introductory, a general view of the art of building among the ancients, 4 hours; Tuesday and Friday, 5 to 7.
53. General views of the history of the *Renaissance*, 4 hours; Monday, Wednesday, Thursday and Saturday, 5 to 6.
54. History of painting and sculpture since the fifteenth century, 4 hours; Monday, Tuesday and Thursday, 11 to 12; Saturday, 6 to 7.
55. Archæology of Christian Art, 2 hours.
56. Classic and German mythology, 2 hours.
57. Greek anthology, 2 hours.
58. Political economy, 3 hours; Monday, Wednesday and Friday, 6 to 7.
59. International law, 2 hours; Tuesday and Thursday, 6 to 7.
60. Commercial law, 3 hours; Monday, Wednesday and Friday, 4 to 5.
61. Forestry laws, 1 hour; Tuesday, 3 to 4.
- d. Fine Arts.*—62. Landscape drawing, 4 hours; Thursday and Friday, 2 to 4.
63. Drawing the figure, after copies and models; Monday, Tuesday and Thursday, 2 to 4.

64. Modeling in earth and plaster, for students in architecture and engineering, 2 afternoons; Monday and Saturday, 1 to 4.

65. Designing ornaments for buildings, furniture, and other productions of arts and trades, 4 hours; Monday and Tuesday, 10 to 12.

Instruction in German will be given, if thought necessary.

#### APPARATUS, ETC., FOR INSTRUCTION.

*a. Collections.*—During the year 1855–6 collections have been commenced, and carried to a point nearly as follows:—

*For drawing the figure.*—Parts of the body, and entire figures. Simple outlines, and shaded designs after the different methods of Julien and Volpats. Models by Albin and Mart. Fischer, for instruction in plastic anatomy. A prepared human skeleton. Busts and detached portions of the body in plaster, mostly after the antique.

*For landscape drawing.*—Lithographs of Calame; studies by the professor.

*For architectural drawing.*—Including constructions in wood and stone and architectural decoration, by different masters. (See below, under *Library*.)

*Models of construction.*—Collection of pieces of wood; models of roofs, mostly after Moller; various arches for doorways; all from the establishment of Schroeder at Darmstadt. This collection will be completed as soon as possible, from the rooms for working in wood and for making models.

*Plaster models of architectural ornaments.*—Capitals and bases of antique columns, and other portions of monuments of antiquity, mostly from the archæological collections of Paris.

*Instruments for land surveying.*—Large instruments for measuring angles; including, a repeating theodolite and another smaller theodolite, by Brunner of Paris; five leveling instruments, from Ertel of Munich, Starke of Vienna, Kinzelbach of Stuttgart, and Goldschmidt of Zürich; four surveyor's tables; and other instruments, by Goldschmidt of Zürich and other Swiss makers.

*For drawing plans.*—Designs, partly by Prof. Bardin, of the Polytechnic School at Paris, but principally by Prof. Wild.

*Astronomy.*—Various small instruments which have been used during the summer for the practical exercises carried on in the small observatory at Zürich, which has been temporarily put in order for the purpose.

*Machines.*—Models for the transformation of motion, from Prof. Walter of Augsburg. (Engrenages,) by Schroeder of Darmstadt. Models of turbine wheels on a large scale, and section models of steam-engines, are being constructed in the work-rooms of the school.

There is a Weissbach's hydraulic apparatus, with its accessories, for instruction in mechanics.

*Library.*—During the year which is all that has elapsed since the foundation of the library, there have been collected about 2,000 volumes, most of them upon the various mathematical and applied sciences taught in the school, and of which a small number appertain specially to the sixth division. One set of works with copperplates, on the art of building, is of great value.

In the reading-room are to be found thirty journals, mostly technical and mathematical, but some upon other sciences.

The library was opened January 27, 1856, since which time have been given 610 discharges of receipts for books taken home. Besides most of the professors, 62 pupils of the polytechnic school have made use of the library.

There are at Zürich collections in natural history, an archæological collection, a library for natural history, and another for the sciences; to all of which pupils can have access.

*b. Scientific and Technical Departments.*—*Chemical laboratory for analysis.* This is arranged for practical men, and well provided with all the necessary apparatus. Two afternoons are employed in the obligatory practice of the regular pupils, to whom the laboratory is always open at other times. During the first term, 11 regular scholars and 14 attendants on lectures made use of it, and during the last term, 11 of the former and 10 of the latter.



*Laboratory of chemistry for technical and pharmaceutical operations.*—This, after some small changes shortly to be made, is calculated for sixteen practicing scholars. Some large apparatuses necessary in a technical laboratory have not yet been erected, on account of want of room; but there is a sufficient supply of other apparatus. The collection of articles for use in chemical instruction is already begun. This laboratory has been attended during the first term by two regular pupils and three attendants on lectures, and during the second, by two of the former and five of the latter. The operations performed by the regular pupils are adapted to their future employment.

*Cabinet of natural philosophy.*—The collection of instruments of natural philosophy has been hitherto provided with instruments chiefly coming from the manufacturers of Paris and Berlin. The Regnault's steam apparatus is by Galaz, the thermometrical apparatus, by Fostée, the optical apparatus by Duboscq, of Paris, and all the electrical apparatus from Berlin. Various instruments have been procured, also, from other German or Parisian manufacturers. During the lessons, use has also been made of the apparatus belonging to the canton of Zürich, which are deposited in the same place.

Convenient accommodations are yet wanting for exact physical experiments and large operations.

*Workshop for making models in metals.*—During the first term, fifteen regular pupils and 1 attendant on lectures have been employed here, and the same number during the second. It contains ten vices, with the instruments belonging to them; but those which are least used are fewest in number. One vice, with a more complete set of tools, is appropriated to the adjoint professor in charge, and each of the others is used during one term by a set of pupils who use it alternately. Each vice, and the tools belonging to it, are designated by a certain number. The most important large instruments in this workshop are, a lathe for turning metals, arranged also for cutting screws; a hand machine for planing metals; a boring machine, shears, &c.; a forge with a small ventilating blast on the American plan, to work by hand, with anvils, tongs, and the whole apparatus of a complete small forge.

*Workshop for models in wood.*—This was used during the first term by seven regular pupils and three attendants of lectures, and during the second by five of the former and two of the latter. It contains five carpenter's benches with their fittings, one of which is set apart for the adjunct professor, and the others are used by the pupils. There is also a turning-lathe for wood with the tools. The vices and benches are numbered, and the tools belonging to each has the same.

As almost all the pupils who have been at work here during the current year has had no previous practice, the first months were occupied in teaching them how to handle the tools. In the workshop for metals they filed cubes, and in that for wood, learned to use the principal tools. Afterwards they were set to construct models of machinery; and in the former of the shops the pupils have been made to do as much as was possible, the instructor only putting on the finishing touch.

The models completed are as follows:—

1. Section model of locomotive cut-off, with Stephenson's (coulisse.)
2. Section model of locomotive cut-off, on Gooch's plan.
3. Diagram showing the excellences of the different locomotive cut-offs.

There is, not yet completed, a locomotive cut-off on the plan of Heusinger of Waldegg.

In the workroom for wood, except a model of a roof by a pupil who had practiced before, no large model has been made; the pupils have been altogether employed in making presses for their tools. Both pupils and teacher have had to employ much time in finishing off their workroom, and preparing it for use, and to construct (especially the teacher) a large supply of simple tools: and the same is the case in the workroom for metals.

During the coming year, in which the number of pupils will constantly increase, the directors will endeavor to have constructed various small machines for the collections, and especially models which may be used in the course of instruction; and will endeavor to make all the scholars assist in this design, each according to his capacity.



The instructors in charge of the work will use all their time, outside of the hours of instruction, in the workshop and in finishing difficult models.

*Workshop for modeling in earth and plaster.*—There have been prepared plaster models of stonework, to a given scale, according to the theoretical course in stone-cutting, and also architectural ornaments and parts of the body modeled in earth and afterwards molded in plaster. The workshop, besides the pupils regularly employed in it, has been used during the first term by nine others, and during the second by three. Most of these others were obliged during the latter term to return to their own practical vocations. The professor (the sculptor, M. Reiser,) does all his own work, whether in earth, plaster or marble, in the shop before the pupils, so that they are enabled to learn the technical execution of such work, and at the same time form their taste.

All these workshops have been open to the pupils during the whole day, excepting hours of instruction, and the masters have been constantly present.

#### METHOD PURSUED IN INSTRUCTION.

The instruction in the studies obligatory upon each division has consisted partly of drills (*répétitions*), exercises and practical demonstrations in the course of technical and scientific excursions.

Regular drilling exercises have been arranged, especially in the departments relative to mathematical and natural science. During most of these, as those in pure mathematics, descriptive geometry, mechanics, &c., numerous problems have been proposed in the course of the year, whose solution has in part been required of the pupils within a given time, in part left to their option, or examined by the professor and discussed with the pupils.

Among practical exercises, intended almost exclusively to stimulate the individual faculties of the pupils, are; those in design and construction, of the pupils of the schools of architecture, civil engineering and industrial mechanism; those in land-measuring, of the first year of the school of engineers, in which a whole day per week is employed; the manipulations in the analytical and technical laboratories; and the work in the shops. Pains have been taken to induce the pupils to spend most of their time not occupied in lessons, in the drawing-rooms, laboratories and workshops, and to consider them their own habitual places of labor.

But great hindrances to this plan have arisen from the great distance apart of the various departments of the school, which causes the loss of much time in the frequent comings and goings of the pupils, and from the fact that the timetable for study has not been arranged in a manner entirely satisfactory.

Excursions have from the first been regularly made with the pupils in the school of forestry, in the forests near Zürich. Prof. Marchand also took his pupils to the meeting of the Society of Swiss Foresters, which was held this year at St. Gall, that they might hear the discussions. Prof. Heer, has also regularly made short excursions, besides one long one, for the sake of instruction in botany. The pupils of the second year in the school of engineering have visited, under the direction of Prof. Calmann, besides the bridges near Zürich, the iron bridge over the Sitter near St. Gall, of which last they took drawings and measures in sufficient detail to enable them to execute, in the drawing-rooms, complete designs of that interesting work. The thanks of the institution are here offered to the engineers employed there, for their kind attentions to the professor and to his pupils.

A long excursion with a view to chemical and mechanical studies was undertaken by Profs. Bolley and Reuleaux, with the pupils of their divisions. They visited various places near the Rhine and above Basle, and returned by way of Basle and Aaran. In the course of this trip the pupils were enabled to examine a furnace and set of trip-hammers, a tin-work, a rolling-mill, a salt-work, a wood-gaswork, which was especially interesting to the pupils, as one had also been recently constructed at Zürich. They also examined a cement-kiln, a manufactory of chemicals, one of printed goods, silk spinneries, &c. The proprietors of these establishments, with a politeness which deserves our acknowledgements, allowed us to take many drawings in them.

A measure similar to that adopted by several other industrial institutions, is the establishment of monthly competitions at prescribed tasks. The regulations for these are contained in the annual programme.



## PROGRAMME FOR 1867-68—SIXTY-TWO PROFESSORS.

## SUBJECTS OF INSTRUCTION, CLASSED BY DIVISIONS.

FIRST DIVISION, OR SCHOOL OF ARCHITECTURE. (*Course three years.*)

*First Year.*—Differential and integral calculus; Descriptive geometry; Construction of buildings, (2 courses;) Architectural design; detailed drawings of plans of buildings; Designing the figure; Ornamental drawing; Landscape drawing; Theory of contacts and intersections of curved surfaces, stone cutting; History of ancient art; Modeling in clay and plaster; Experimental chemistry.

*Second Year.*—Art of building (2 courses,) embracing art of building civil edifices in middle ages and in modern times; Practical exercises in building; Theory of shadows and perspective; Mechanics, theory of machines; Construction of bridges and roads; Drawing of figures; Construction of arches and vaults.

*Third Year.*—Practical exercises in building; Ornamental drawing; Technical geology; Law concerning buildings; Chemical technology; Lithology, with practical exercises.

## SECOND DIVISION, OR SCHOOL OF CIVIL ENGINEERING.

*First Year.*—Differential and integral calculus (2 courses;) Descriptive geometry; Art of building and drawing; Drawing of plans; Experimental physics; Experimental chemistry.

*Second Year.*—Theory of differential equations; Differential and integral calculus; Industrial mechanics; Geometry of position; Theory of shadows and perspective; Technical geology; Topography, drawing of charts; Description of machines and drawing of plans.

*Third Year.*—Theory of machines; Astronomy; Geodesy; Construction of bridges and rail-roads, with designs; Administrative law; Drawing of maps; Construction of iron frame-works; Technology of building material; Astronomy, with exercises in the observatory; Practical and theoretical surveying; Lithology.

## THIRD DIVISION, OR SCHOOL OF INDUSTRIAL MECHANICS.

*First Year.*—Differential and integral calculus (2 courses;) Descriptive geometry, with exercises; Analytical geometry of surfaces, with exercises; Drawing and designing of machines; Experimental physics applied to mechanics; Experimental chemistry.

*Second Year.*—Theory of differential equations; Differential and integral calculus; Industrial mechanics; Art of constructing machines (2 courses;) Selected portions of the same art; Technology of mechanics; Science of motion.

*Third Year.*—Theory of machines; Construction of models in wood; Construction of models in metal; Regulators; Metallurgy; Technology of building material.

## FOURTH DIVISION, OR SCHOOL OF INDUSTRIAL CHEMISTRY.

*First Year.*—Inorganic chemistry; Organic chemistry; Selected portions of organic chemistry; Experimental physics; Manufacture of chemicals; Glass and pottery; Description of machines; Mineralogy; Elements of general botany; Geology; Industrial drawing; Chemical analysis in the laboratory; Zoölogy; Chemical experimentation applied to industrial arts.

*Second Year.*—Bleaching, dyeing and printing of tissues; Practical manipulations in the laboratory; Technology of machines; Crystallography applied; Practical geology; Industrial chemistry; Industrial drawing; Analysis in the laboratory.

*Third Year.*—Organic experimental chemistry; Analytical chemistry; Metallurgy; Chemical technology of building material; Special botany; Classification of minerals, with exercises; Heating and lighting of buildings; Food and nutrition; Pharmaceutical chemistry for druggists and apothecaries; Pharmaceutical botany; Pharmaceutical chemistry; Technical portion of pharmacy; Raw materials pharmaceutically considered; Manipulation in the laboratory of pharmaceutical chemistry; Toxicology.

FIFTH DIVISION, OR SCHOOL OF FORESTRY. (2 years' course.)

*First Year.*—Mathematics in reference to practical uses in forest culture; Botany; Topography; Drawing of plans; Science of managing forests; Excursions and exercises in valuation; Experimental chemistry; Law concerning forests; Mineralogy; Geology; Zoölogy.

*Second Year.*—Exploration of forests; Preservation and utilization of forests; Management of forests by the state; Statistics and literature of forestry; Climates and soils applied to forestry; Technical geology; Construction of bridges and roads; Administrative law and police; Botany and entomology applied to forestry; Agricultural chemistry; Lithology; Practical surveying; Industrial physics.

SIXTH DIVISION, OR NORMAL SCHOOL OF MATHEMATICS AND NATURAL SCIENCE.

*Section a. Mathematics.*

*First Year.*—Differential and integral calculus; Analytical and plain geometry, with practical exercises; Introduction to analytical geometry; Analytical geometry, with practical exercises; Experimental physics applied to arts.

*Second and Third Year.*—Theory of differential equations; Theory of functions; Geometry of position, with practical exercises; Astronomy; Selected portions of higher astronomy, with exercises; Technical mechanics; Theory of life insurances; Analytical mechanics; Mathematical theory of gravitation, of electricity and magnetism; Physical geography; Mensuration of bodies.

*Section b, Natural Sciences.*

*First Year.*—Practical and analytical chemistry; Selected portions of inorganic experimental chemistry; Mineralogy; General botany; Zoölogy.

*Second Year.*—Praxis in industrial chemistry; Crystallography applied; Microscopical exercises; Mensuration of bodies; General geology; Antediluvian plants and fossil insects.

SEVENTH DIVISION, OR SCHOOL OF LITERATURE, MORAL SCIENCES AND POLITICAL ECONOMY

*a. Natural Sciences.*—Experimental physics; Microscopical exercises; General botany; Physical geography; Geology; Zoölogy; Pharmaceutical botany; Fossil plants; Fossil insects; Mineralogy; Compounds of cyanogen; Polyatomic alcohols; Essential oils and aromatic compounds in general; Paleontology; Geology of sedimentary formations; Pharmaceutical chemistry; Toxicology; Selected portions of experimental chemistry; Fossils characteristic of the geological formations of Switzerland; Physical chemistry; Stoechiometry; Analytical chemistry, qualitative and quantitative; History of chemistry; Repetitions of organic chemistry.

*b. Mathematical Sciences.*—Elementary astronomy; Theory of life-insurances; Theory of surfaces of the second degree; Elements of differential and integral calculus; Exercises in differential calculus; Exercises in industrial mechanics; Analytical mechanics; Mathematical theory of gravitation; Light, electricity and galvanism; Determinants; Higher mechanics; Political arithmetic, (interest, rent, savings banks.)

*c. Languages and Literature.*—History of ancient German literature to the end of the 17th century; Exercises in oratory; History of literature; Molière and his time; Lecture on and explanation of the *Cid of Corneille*; Lecture on and explanation of chosen pieces from the *Lettres Persanes de Montesquieu*;



Exercises in the French language; History of English literature; English novels; Shakspeare's Julius Cæsar; Exercises in the English language; La commedia dell' arte in Italia e fuori d'Italia; La pocsia ispiratrice di Raffaello e del Correggio; Exercises in the Italian language.

*d. History, Moral Sciences and Political Economy.*—History of the time of Frederick the Great and the French revolution; Sixteen characters of universal history—Pericles, Demosthenes, Alexander the Great, Hannibal, Cato junior, Tiberius, Attila, Mahommed, Charlemagne, Gregory the Seventh, Johanna of Arc, Richelieu, Cromwell, Peter the Great, Washington, Cavour; General theory of political economy; Commerce of the world from the foundation of the United States of America up to the present time; Exposition and discussions on questions of political economy; History of ancient art; History of modern painting since the introduction of oil-colors; Commercial law; Political economy; Critical studies of the doctrines of socialists and of reformists; Elementary course of international law; Laws of the Swiss confederation; History of Switzerland under the Helvetic republic; The British empire in the five divisions of the globe; History of geography (2 courses;) Introduction to geography, industry and commerce; Explanation of the sculptures in the museum of archæology.

*e. Fine Arts.*—Drawing of ornaments and decorations in the interior of buildings; Landscape drawing; Drawing of heads and figures from models; Modeling; Theory of harmony.

EIGHTH DIVISION—PREPARATORY COURSE OF MATHEMATICS TAUGHT BOTH IN FRENCH AND GERMAN; MODERN LANGUAGES.

Algebra; Geometry of space and plane trigonometry; Elements of descriptive geometry; Practical geometry; Experimental physics; Experimental chemistry; Instruction in German; Instruction in French.

BUILDINGS OF THE POLYTECHNICUM AT ZURICH.

At the founding of the school, the canton and the city of Zurich pledged themselves to erect a suitable building, and this subject was, in 1855, taken into consideration by the school committee, the authorities of the cantons and the council of the Swiss confederacy, but nothing resulted from it until 1858, when the grand council of Zurich appropriated 1,700,000 francs (\$340,000) for the erection of a building planned by Prof. Semper and Superintendent Wolf. In this building there was to be all necessary room for the Polytechnic School and also for the University of Zürich.

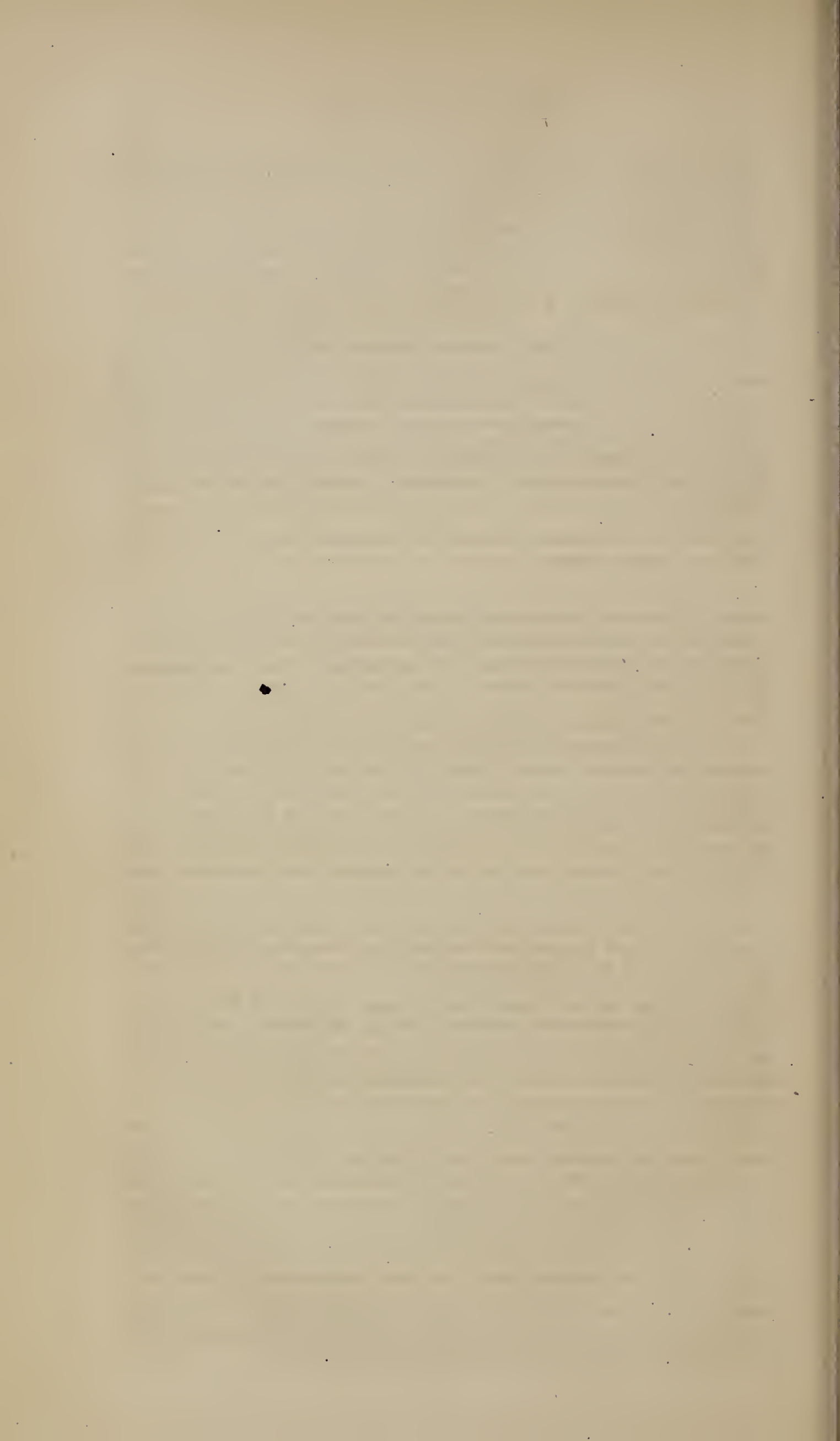
The locality chosen is a little distance from the centre of the city, but has the advantage of an open prospect, perfectly quiet surroundings, and excellent light on all sides. It is a natural terrace of the woody mountain of Zürich, and is 160 feet above the lake; the imposing front of the building is turned toward the city, and is an attractive feature in its surroundings.

The school accommodation consists of the main structure and the chemical department. The main structure forms a rectangle whose longest side is 426 Swiss feet and the shortest side 256 in extent. A pavilion separates the interior quadrangle into two courts, furnished with fountains. The front is renaissance, and the pavilion is adorned with Corinthian columns. The whole is constructed of light green sandstone.

There are four entrances, the main entrance being in the pavilion, consisting of a vestibule with adjoining staircase, ornamented with Tuscan pillars; contiguous to this is the noble hall for antiques, 72 feet long and 56 wide, which contains the beautiful plaster molds of the archæological museum. The halls for lectures and for design are all light and spacious, room being left for new collections. The whole building is excellently arranged; it is heated by steam-pipes.

Behind the main building is the well-arranged chemical school, and a little farther towards the mountain side is the new observatory, built after Prof. Semper's plan.

The cost of the main building, together with the chemical department, amounted to two million francs, (\$400,000;) that of the observatory, 130,000 francs, (\$26,000,) without estimating the outlay for the interior.





# PESTALOZZI, DE FELLEBERG AND WEHRLI,

AND INDUSTRIAL TRAINING.

BY WILLIAM DE FELLEBERG.\*

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EARLY in the year 1798, Switzerland, whilst at peace with the French republic, was invaded by a numerous French army on the most frivolous pretexts. Amongst the Swiss Cantons which offered the most energetic resistance to the encroachments of the French Directory, Unterwalden stood in the first rank. Fearful was the vengeance of the enraged French soldiery, who devastated that unhappy country with fire and sword. The inhabitants who did not fall in battle (women as well as men having shared in the fight) fled, some into the mountains, some into the churches; but the churches did not protect them from the flames or bayonets, to which all the native sufferers became a prey; the children were however spared; and crowds of these homeless orphans were to be seen, after the departure of the French, wandering about amidst the ruins of the villages. A wail resounded through Switzerland when this was known.

The first philanthropist who devoted himself to the succor of these helpless objects, was Henry Pestalozzi, then Theological candidate. He had just before broken down utterly in preaching his probationary sermon—a circumstance which was a bar to his prospects in the church, especially at such a seat of learning as Zurich. He did not know where to direct his steps; the career of professional theology was closed to him, but not that of Christianity. He converted his little property into money, tied up his bundle, and set off to the Canton of Unterwalden, there to become the guardian of the poor deserted children. The season was inclement, but he succeeded, with the help of some kind-hearted friends, in forming a shelter for his new family, amongst the ruins of the little village of Hanz. Here Pestalozzi fed, clothed, and housed the gathering flock, increasing in numbers till he was obliged to consider how he could bring them under some kind of discipline; but for this purpose he had no help except from the children themselves. He therefore chose from amongst them the most intelligent, taking care to select those who had most influence with their companions. These he appointed his assistants (“lieutenants”) in the lessons, as well as in the necessary household work, such as keeping the place in order, mending clothes, collecting wood, &c. He soon added to these occupations the cultivation of a small

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\* Communicated to the “National Association for the Promotion of Social Science,” by Lady Noel Byron, and published in the “*Transactions*” for 1858.

piece of land; and the little colony assumed the aspect of an orderly community.

In the meantime patriots from various parts of Switzerland had arrived in Hanz, bringing provisions and stores of all kinds. The fugitive inhabitants gradually returned from the mountains, and all fell into their former way of life. Pestalozzi's school was welcome to all as long as the children were fed and provided for in it; but his funds being exhausted, and the aid of the benevolent being required for the returning fugitives on their own account, there were no means of maintaining the establishment. Thus, to the great sorrow of every one, Pestalozzi felt the necessity of separating from his beloved children. Still the recollection of his Unterwalden family, and of the kind of training which he had been driven to employ from the failure of other resources, remained a living picture in his mind. It gave a distinct and tangible aim to his deep inward longing to serve his fellow creatures; it became the vision of his dreams, the object of all his plans; and he caught at whatever promised to bring him nearer to the desired end. In consequence, all his intercourse with friends—for he found many after the events of Unterwalden—was directed to the same end. To most of them, however, he spoke in riddles; since they could not have understood him unless they had like him learned, by experience, how powerful an instrument for training the young is to be found in labor for bread, when under skillful management. By all true philanthropists, indeed, the full value of Pestalozzi's work in Unterwalden was recognized; and in its merits his unsuccessful sermon was forgotten. Great hopes were formed of the results of such rare self-devotion, and many anticipated that a new light on education would be kindled by it. When he made known his project of an educational institute, the government of the canton of Berne offered him the use of the Château of Burgdorf for that purpose. He accepted the offer, and opened a school in that place.

Pestalozzi's reputation, founded upon some striking works for the people, "*Leonard and Gertrude*," with others, brought him immediately a great number of pupils; some of them out of the most influential families, with whom he had an opportunity of putting in practice one part of his educational system, called by himself the "*Anschauungs Lehre*," teaching by sight and other senses. But his industrial training could not be carried into effect, because his pupils were chiefly of aristocratic families, and not obliged to support themselves by manual labor. He consoled himself, however, with the hope of saving enough out of the income derived from the school payments of the rich, to establish a small agricultural school for the poor, on his own plan, in connection with the institute.

His new system already began to excite public attention. Young men of the teachers' class thronged around him, and endeavored, with more or less success, to acquire his method, hoping thereby to make their fortunes in the novelty-loving world; but amongst all those who were thus brought into contact with him, there was not one who could comprehend



his great idea, that of making LABOR, more especially *Agricultural Labor*, a principal means of training the young; indeed, had he found such a one it could not have helped him; for in his fortress there was not a foot of ground in which any thing could be planted.

An opportunity was soon afforded of carrying out the aim of his heart by these circumstances. Amongst the acquaintances Pestalozzi had made in earlier times, during a journey before he went to Unterwalden, was the family of Tcharner, of Wilden Stein. Tcharner, who was the Bernese Landvogt, appeared to Pestalozzi to realize his idea of what a governor ought to be, such as he had drawn in his most celebrated work, "*Leonard and Gertrude*," in the character of Arner. Through this family he became acquainted with that of De Fellenberg, who succeeded Tcharner in the government of Wilden Stein; and a young De Fellenberg became one of Pestalozzi's most attentive listeners. This young man accompanied him on several journeys, and was one of the few who afterwards entered into, and adopted, his idea of industrial education. But it was a circuitous route by which De Fellenberg came to the resolution of acting out Pestalozzi's idea. He was educated for a political career, but his mother's character had implanted in him the germ which enabled him to receive and comprehend the ideas of Pestalozzi. His mother used to say to him: "*The Rich have always helpers enough, help thou the Poor.*"

It was during the early days of the French Revolution that he studied law at the University of Tübingen, in Germany. Returning just as the difficulties of Switzerland with the French were beginning, he then heard of Pestalozzi's school in Unterwalden, and was vividly reminded of his former acquaintance with him. Other circumstances also concurred to give the bent to his mind, which changed his path in life from that of a politician to that of a philanthropist.

The tremendous war taxes which the French Directory exacted from the Swiss, and the pressure of the military occupation on the country, brought Switzerland to the brink of despair, and it was resolved to send an embassy consisting of the leading men to Paris, in order to entreat the directory to lighten these burthens. De Fellenberg accompanied one of these ambassadors as secretary; and what he then saw of French freedom, and the political tendencies of that time, convinced him that he must seek another path. He returned to Switzerland, more than ever determined to serve his country in the spirit which had been awakened in his early youth by that saying of his mother. He soon afterwards married the grand-daughter of Tcharner, the before-mentioned friend of Pestalozzi, and was henceforward brought more into contact with him. About this time De Fellenberg's father, who was professor of law in Bern, purchased the estate of Hofwyl, near to that city, in order to give his son a field of action. Hofwyl is only nine English miles distant from Burgdorf. Thus De Fellenberg and Pestalozzi became neighbors, and this led to frequent interchange of thought between them, in which Pestalozzi endeavored to induce De Fellenberg to employ his estate in real-

izing his favorite idea of industrial education. Pestalozzi had at that time competent teachers for the promulgation of his method of teaching. Each of these teachers imagined himself at least a younger Pestalozzi, who owed the father Pestalozzi just as much subordination as seemed good to themselves, and no more. Thus, in a few years after its foundation, the institute presented a picture of anarchy; and Pestalozzi felt himself incapable, through diminished practical powers, of reorganizing it as was required, and placing it on a firm basis, which he thought De Fellenberg could best accomplish.

The Bernese government possessed a building, once a convent, near Hofwyl, called München Buchsee, and Pestalozzi proposed to the authorities to give it him instead of Burgdorf. He offered the entire management of his institute to De Fellenberg, and the government consented. De Fellenberg made a stipulation that he should have the power of dismissing any of the teachers who should not conform to his regulations. Pestalozzi agreed to this, and transplanted his establishment to München Buchsee, which is only ten minutes' walk from Hofwyl. Here De Fellenberg had an opportunity of judging of Pestalozzi's method, and of seeing both its strong and weak points. He was also able to enter into Pestalozzi's further schemes. It is scarcely to be doubted that the dominant idea of Pestalozzi would have been then carried out at Hofwyl under his own eyes, if the characters of the two men had been such that they could labor together in the same work with success. But in their daily intercourse it soon appeared, that Pestalozzi's excessive kindness of heart led him to regard as tyranny a consistent prosecution of that plan; while De Fellenberg, from his characteristic energy, bore Pestalozzi's want of decision impatiently, and treated it as loss of time. It was, therefore, not difficult for Pestalozzi's assistants to persuade him that he had fallen into the hands of a tyrant, from who he should release himself at any cost. He therefore accepted at once the offer from the government of the Canton Waadt (Pays de Vaud) to give up to him the Schloss Yverdun, on the lake of Neuchâtel, for the reception of his institute; and thus ended the connection between Pestalozzi and De Fellenberg, without, however, any personal disagreement. Pestalozzi rejoiced extremely when, in 1806, De Fellenberg sent one of his sons to him to be educated, accompanied by a young man, as tutor, who should acquire a knowledge of Pestalozzi's system.

De Fellenberg meanwhile, at Hofwyl, had come to the determination to begin the work of industrial education, and the only question with him now was, to find an able assistant who could fill the position of "*Father*" to his pupils, and as such embody his idea. After having sought among a considerable number of young men of the educating class in Switzerland, he found the right one in the following manner. Pestalozzi's method of teaching had excited great attention among all engaged in education throughout Switzerland. It seemed so simple to lead the pupil by enlisting his own will, and rousing his own reason to assist in his own instruction, that every reflecting teacher could only



wonder why the idea had not occurred to him long before, as the number of children in a school rendered some such method almost necessary. Many, therefore, endeavored to apply what they had heard of his system, apparently so simple, to the subjects then taught in their schools, reading, writing, the catechism, &c.; but they soon found the task to be much more difficult than they had imagined. Many, therefore, were anxious to study the Pestalozzian method from Pestalozzi himself; but this was too expensive for most of them. The pecuniary affairs of the institute were so involved from mismanagement, that Pestalozzi could not admit any such supernumeraries except for a considerable sum. This led De Fellenberg to think of opening a course of instruction in the Pestalozzian method; on the one hand, to offer to earnest teachers this opportunity of improvement; on the other, with the hope, among the numbers who might assemble at Hofwyl, to find an assistant for his own particular object. He communicated his scheme to Pestalozzi, who was delighted with it, and sent him a young man from Prussia named Zeller, no less thoroughly imbued with his method than enthusiastic in promoting it. De Fellenberg was thus able to open his course of instruction, 1st May, 1806. For this purpose he had a cottage built in a little wood, beneath great linden trees, on twelve posts, and with a single roof. The upper part served as a sleeping-room, the ground-floor as a school-room. In the morning, the hours from five to seven, and from eight till twelve, were devoted to lessons. In the afternoon the teachers worked in the fields and in the garden of Hofwyl. In the evening they prepared the vegetables for the next day's meals. During the harvest they assisted in the fields during the whole day. De Fellenberg, in this way, showed them how an industrial school ought to be organized. He gave them also every morning, a lesson in agriculture, in which he explained the various field operations and their connection. He conversed with them on the subject of making agricultural labor a valuable aid in education, and a subject of instruction for boys. Each evening he talked over with them the labors of the following day. Thus he led the teachers to do their work with intelligence; to take pleasure in it, and to see how advantageous would be to themselves the knowledge thus obtained of agriculture, as the means of making the soil more productive during the rest of their life; for most teachers in Switzerland depend for the principal part of their subsistence on a few acres of public ground.

All this instruction was in accordance with Pestalozzi's ideas—De Fellenberg even carried them further than their originator—for Pestalozzi based his system on the perception of the senses (*Anschauung*), making this the ground work of memory. Former systems had only concerned themselves with the memory, and with matters which could be made objects of perception; De Fellenberg then went beyond Pestalozzi, inasmuch as he added the *action* to the *perception*; “for,” said he, “what has been done, and done with thought, will be retained more firmly by the memory, and will bring a surer experience than that which has been only seen or heard.” Earlier schools made the *ear* and *words* the subject-

matter of memory—Pestalozzi, the *eye* and *picture*—De Fellenberg, *the action*. Zeller, though versed in Pestalozzi's method, followed De Fellenberg's step in advance of it, with the readiness of one desirous of improvement; and brought his objective teaching, as far as possible, into relation with the daily lessons of the teachers—the effect of which was to render them more interesting and animated.

The teachers who took part in these courses of instruction have been heard, even years after, to describe the scene so vividly that it seemed as if they had just come from it; and it has been often proved that whilst other teachers, from want of knowledge of farming, have been ruined in times of distress, such as 1816, 1817, the Hofwylers, as they were called, struggled out of their difficulties by their own exertions.

About thirty joined in the first season's lessons. These, on their return home, mentioned them to their acquaintances. The following spring, no less than eighty teachers made their appearance at Hofwyl. This influx created difficulties for De Fellenberg, as an individual, and caused him some pecuniary embarrassment.

In order to carry out his plans he was obliged to find different kinds of labor, which he would not, perhaps, otherwise have thought of. Among these was drainage, then effected only by means of stones, or with wooden pipes; and as the Hofwyl land was extremely stony, this answered two purposes at once. The drainage water also was turned to account, in watering the low-lying meadows. All these occupations again gave Zeller the opportunity of extending his object-lessons. Instruction in drawing was joined with them; this art being regarded by De Fellenberg and Zeller as a connecting link between perception and action.

The second course was attended by a little schoolmaster, named Wehrli, from the canton of Thurgovie. Although an elderly man, he had set off, on hearing of the new method of teaching, and traveled on foot about one hundred and fifty miles, in order to improve himself in his profession. He was one of the most zealous and attentive students, and endeavored to inform himself as thoroughly as possibly on all points that were new to him. When De Fellenberg, at times, explained to the teachers how agricultural labor might be made a means of education, declaring his own wish to establish an example of such industrial training, if he could only find a capable assistant, it was always old Wehrli who, after the lesson, had most questions to ask; and at the end of the course he said that he had a son whom he could recommend to carry the plan into effect. Induced by his description of his son, De Fellenberg invited him to Hofwyl: and shortly afterwards there appeared before him a youth of eighteen, with a pleasing expression of countenance, modest bearing, but fearless glance, commissioned by his father to enter the service of De Fellenberg. Young Jacob Wehrli was not long in comprehending what De Fellenberg required of him. He only wished, as soon as possible, to be put in command of boys with whom he could set to work. De Fellenberg was so convinced of the certainty of success in



his undertaking, that he did not hesitate to give the first beggar-boy whom he found, as a pupil to young Wehrli. Wehrli was no less confident in its being an easy task to change the most unmanageable of vagabonds into an industrious member of society; and, in fact, the first few weeks of kind treatment, not omitting better food, seemed to make the desired impression which De Fellenberg and Wehrli ascribed to their system. This result was, however, not a little attributable to Wehrli's having shared all the occupations of his pupil, so that when the boy felt weary or idle, he was ashamed to let his master, as he called Wehrli, work alone. When, however, after a few weeks, the better food and kindly treatment were no longer new, the beggar-boy began to long after his former "free life," and tried, instead of working, to go after birds' nests, the eggs of which had formed the luxuries of his former diet; or else he sought out a snug corner to sleep in. When Wehrli said to him, "Those who will not work shall not eat," he took up his tools again, it is true, but as his thoughts were not in his work, his labor was worth nothing, and Wehrli saw that he should not attain his purpose in that way. So it was necessary that the boy should experience the consequence of his idleness, and go to bed one evening without his food. "What," thought he, "I am deprived of my liberty, and must hunger into the bargain?" and the next morning, very early, he took his departure. Thus Wehrli had now no pupil. De Fellenberg himself was astonished that the beggar-boy had not known better how to appreciate his kindness, and he then made a fresh experiment with the son of an industrious laborer, who, burthened with a large family, was glad of the opportunity of providing for one of his children. He was a weakly boy, but willing and anxious to learn, and gave Wehrli more satisfaction. It was not so wonderful that a child out of a laborer's family, should be trained to industry. Still it was attended with much trouble to accustom the boy, somewhat enfeebled by his mother's care, to field-labor. De Fellenberg had said that they would not take a second boy till the first was in good order, that the example of the one might influence the other. The prospect of such a result with this weakly boy was unfavorable, and Wehrli found that he should have to go through the whole winter with but one pupil. At the beginning of the cold days, however, our young friend, the beggar-boy, made his appearance, and promised, if he were received back, to work hard for his bread. It really seemed as if the young vagabond had instituted some comparisons between his "free life" and Hofwyl training, to the advantage of the latter. The two new comrades soon strove which should do his work best—a contest in which the beggar-boy soon gained the upper hand, and took the position of teacher, as he displayed much more skill and aptitude than the other. This satisfied his ambition, and Wehrli took care not to weaken this first germ of civilization in him, but rather endeavored to convince De Fellenberg that they might now receive a third boy; as he had a strong and intelligent assistant in the beggar-boy, and could, at least, depend on the good will of the other lad. Soon there followed a third and

a fourth ; but care was taken not to increase the vagrant element, till the inner strength of the little family might make it safe to do so.

This was the commencement of the agricultural school for the poor at Hofwyl, in which the OBJECTIVE TEACHING of Pestalozzi was brought into action in concurrence with labor. When the pupils reached ten in number Wehrli was able to promote some of them to be his assistants ; not so much in school-teaching, as in the direction of work, arranging that each older pupil should take charge of a younger one, as an apprentice. Such was the type of the ultimate development of the school ; just as in a well-ordered family the elder children lead on the younger ones by their example.

Agricultural labors offer a richer field for this purpose than any other employment. Every sort of capacity is brought into action. Each member of the family performs his part of the common labor, and enjoys the elevating consciousness of being useful to the community. In striving to fill his position well, he learns to act from a sense of duty, and strengthens this virtue by practice. De Fellenberg's pupils, however, were not confined to agricultural labor ; the requirements of his farm, and afterwards of his educational establishment for the upper classes, gave employment to various artizans, as cart makers, carpenters, joiners, blacksmiths, locksmiths, workers in wood, iron, leather, mechanics, shoemakers, tailors. Therefore, the pupils of the lower school, if they wished to learn a handicraft, had a wide choice open to them, without being obliged, during their apprenticeship, to neglect the instruction from books in which they had become interested.

Wehrli's school, gradually increasing from a small family circle to a youthful community, reached the number of 150 pupils, without diminishing in moral strength or intellectual energy. Amongst these a considerable number were trained to become teachers in national schools, and superintendents of similar establishments ; such as are now to be found in most of the cantons of Switzerland, in many German states, in France, in the Netherlands, in Italy, and elsewhere. The greatest service rendered by the system of industrial training, in schools modeled after Wehrli's, has been in those devoted to rescuing juvenile offenders from the path of ruin, and restoring them to society. Up to the present time, the Rettungs Haus, at Bächtele, near Berne, in Switzerland, is one of the best institutions of this nature, and Dr. Wichern, the founder of the Rauhen Haus, near Hamburg, and De Metz, founder of the Colonie Penitentiare, at Mettrai, in France, have employed this system, as the only effectual mode of reclaiming the most abandoned juvenile delinquents.

We must not omit to mention here an observation, confirmed by facts, that wherever such schools have been established with success, they have always, as in the case of Wehrli's, at Hofwyl, arisen out of the small family principle gradually extended. There have not been wanting attempts to organize such schools on a gigantic scale, but few of these have proved themselves strong enough to live. It has always been de-



monstrated that it is not the *system* that can give life, but the *spirit*; the strength, love, and faith of the founder; and all these will naturally increase from the smallest germ, and become strong by exercise. This was proved, too, in Hofwyl itself, for when after forty years' exertions, Wehrli was recalled to his native canton of Thurgovie, to conduct there an institution for the education of teachers, after the model of Hofwyl, De Fellenberg sought his successor from amongst the numerous teachers of the lower school; but not one of the chosen "step-fathers" could take Wehrli's place. The school lost with him its peculiar vitality, and it would have been better to have begun it afresh. De Fellenberg had felt from the first the true position of the wealthy in relation to the poorer classes, and that it would be only half doing his work in the world, if he merely showed what treasures existed in the working classes to be drawn forth. The rich must be taught, at the same time, by what means they could succeed in extracting those treasures. Witnesses were wanted out of the upper classes to the educational elevation of the laboring classes—witnesses who might afterwards carry forward his work. About the time at which he made his first experiment in industrial training, he began an agricultural course for landowners. The success of his plan of deep-soil ploughing, draining, and irrigation, upon the formerly somewhat neglected ground of his estate, was much approved, and brought him a large number of pupils, many of whom also took an interest in his education of the poor. But these young men remained so short a time under his direction, that he could not anticipate the extension of his views in a wider circle through them. He therefore opened, in 1809, his educational institute for the upper classes, of the same kind as that which Pestalozzi conducted at Iverdun—afterwards extensively known—and he here made use of the experience which Pestalozzi had gained during many years with his objective lessons.

In working out his method, Pestalozzi had arrived at a somewhat one-sided system of instruction, founding all on his pupil's own perceptions. He excluded traditions far too much, so that it was said of him that the whole past of human cultivation was lost to his pupils—as, for instance, history. De Fellenberg endeavored to avoid this one-sidedness in his school, by giving the study of history its place, adapting it with care to the young. On the other hand, he strove by every means to afford to the pupils of his higher school a field for the development of their powers of action. He introduced extensive gymnastics, including military exercises, swimming, riding, pedestrian exercises, turning, and similar mechanical occupations, gardening, and skating. At the same time, under the guidance of a special master, the boys formed a kind of independent community amongst themselves, for the management of their own affairs out of school-hours; arranging their various occupations, as well as games of all kinds, their walking tours, gardening, &c. They chose their own officers, punished casual offenders, and thus practiced obedience to self-imposed law. In this manner De Fellenberg strove, with these pupils also, to promote action and the discipline of life, as the

actual means of education; and to lay the foundation of self-reliance in the man by the cultivation of self-government, and various capabilities in the boy and youth, so that in the upper school also, the prominent feature was *education by action*, which coincided with the industrial training of the lower or poor school.

The two institutions were brought into contact in many ways. Pupils of the upper school who required physical strengthening, or muscular exhaustion, so to speak, as was the case with many, were sent for a time to field-labor in the lower school. In both cases, labor acted as a wholesome medicine, whilst the boys themselves regarded getting up at three in the morning to earn a breakfast with a thrashing flail as one of their greatest pleasures. Many amusements were shared by both schools—for instance, skating and sledging in winter, and gymnastic games in summer. The sons of the wealthy learnt from pupils of the lower school to respect labor, whilst the poor viewed their richer companions not as enemies but as sympathizing friends. The pupils of the upper school kept a poor-box, into which were paid all the small fines, and the voluntary contributions of the boys also, on Sundays, after the religious services. These funds afforded them the means of helping the sick and infirm people whom they met with in their visits to the poor families round Hofwyl. Such visits were usually made on Sunday afternoons. Thus also was Sunday sanctified, not by words only, but by deeds.

In order to awaken yet more sympathy in the sons of the rich for the education of the poor, a little colony from the lower school was at one time established in a wood, about six miles from Hofwyl, on an inclosure of about twelve acres. The walls of the dwellings were of clay, and were the work of the pupils of the upper school. The doors, windows, floor, ceilings, partitions, beds, tables, chairs, and cupboards, were made by the young carpenters of both schools; and it was a common festival for all when the first four pupils, with their teacher, were established in the new colony, on which occasion the chief enjoyment consisted in this, that both schools joined in digging and in preparing for planting the piece of ground destined for a garden. For several years, one of the most favorite Sunday walks was to visit the new colony and observe its progress.

Thus it was that the practical working, as well as the theory, of agricultural poor schools was carried by Hofwyl pupils into distant countries; and thus, too, the boys of the upper school took away with them more correct notions of active beneficence, as well as of the duties which property imposes upon its possessor.

This education earned much approbation from the public, and the number of pupils increased in a short time. Their payments enabled De Fellenberg to extend the Poor School, which we before mentioned. It also made it possible for him to give several "courses" for the benefit of earnest teachers; and amongst them he discovered young men who attached themselves, willingly and efficiently, to his work of training the poor, assisting him to spread it abroad.

Among the many strangers who visited Hofwyl, some, who were not



satisfied with seeing what was done there, inquired into the possibility of founding similar institutions in their own homes. Then it always appeared necessary, as a first condition, to have a Wehrli; and De Fellenberg perceived that, if all these good intentions should be carried into effect, he must consider how he could procure more than Wehrli. He was now able to make use of those young men whom he had found qualified, in the course of his classes, for teachers, and without whom it would have been impossible for him to extend his system thus widely in so short a time. For however simple at first sight the idea might appear, that the same means which renders the individual capable of self-support—namely, his development as a worker, should be made the chief agent in his education—nevertheless, such simple ideas are only suggested by that common sense which Diogenes sought with a lantern in broad daylight. To carry them out into practice requires a self-denial and devotion, which is the fruit of a long exercise of Christian virtues.

Pestalozzi's original ideal was thus realized in Hofwyl. He had practiced his method of instruction at Iverdun, at first with great success; but here, again, his want of capacity for management stood in his way.

We are far, however, from wishing to depreciate, in the smallest degree, the great service which he rendered in the furtherance of true popular education. If his *objective* system did not entirely develop industrial training, it may at least be considered as having given the first impulse in that direction. What must above all be regarded in all he did is his inexhaustible love for the young, to express which, he could scarcely find words. It inspired every one with whom he came in contact, and became the distinguishing characteristic of his true disciples. If his system embraced but few subjects of teaching, its deficiencies were compensated for by the intensity with which it acted upon such as could be brought within its sphere.

Pestalozzi's simple motto was, "Nothing can be learned except through comparison of the unknown with the known;" and, again, "Every thing is contained in the child; the teacher must know how to draw it out by love and patience: love can always find means." To teachers he often said, "Go, and learn of the mother."

The young, according to his view, could only know by the physical perception which requires repeated exercise to advance to mental perception. What the eye sees must be thoroughly comprehended by means of feeling, hearing, smelling, tasting, in order that the verbal description of the object and its properties may be perfectly understood. Then the teacher proceeded to numbers and measures, and lastly drawing came in to complete the external image.

From this short sketch of the course pursued by Pestalozzi's method of objective teaching, it will be seen that it was especially calculated to qualify and prepare its scholars for the study of natural science; and it is evident that in agriculture lay the richest mine for the practice of objective teaching. As a farther development of his system, Pestalozzi

could not fail to look with satisfaction on De Fellenberg's agricultural school at Hofwyl. If we cast a glance at the studies of the naturalist—as widely comprehensive as they are deep and searching—and upon their manifold uses in common life, we can scarcely fail to acknowledge, with gratitude, in Pestalozzi's system one of the influences which have helped to promote and facilitate scientific pursuits.

De Fellenberg pursued his work at Hofwyl, in the manner before described, till the year 1844. We have mentioned how offshoots of his work for educating the poor were formed with success in most of the cantons of Switzerland, and the adjoining countries; and he could look upon his life with the consciousness of having begun a work that would advance and develop itself through the inherent truth of the principle which it represented.

It is very significant of the effect produced by the efforts of Pestalozzi and De Fellenberg, that when, in 1844, the erection of a national monument to Pestalozzi was talked of, and men of all ranks met to consider the subject, it was agreed, without opposition from any quarter, to abandon the idea of a stone or bronze statue, and raise instead of it, a living memorial to the father of Swiss education, consisting of an institution for the training of poor children of both sexes, in accordance with his ideas, and after the model of Wehrli's school at Hofwyl. This monument is still flourishing, and will be a blessing to coming generations.

De Fellenberg's institutions at Hofwyl did not escape the fate of all human affairs. He died in 1844. The political events of 1845-48 caused a dissolution of his schools at the moment; but his system was too firmly established in Switzerland, by means of numerous training and other schools, to be effected by the continuance or discontinuance of Hofwyl. That which he sought to accomplish by means of his schools was achieved:—1. Switzerland had obtained a system of popular education, having its foundation in the wants of the nation, and which it could henceforth develop independently, as there was scarcely a place of any importance in the country where there was not a pupil, either of Pestalozzi or De Fellenberg, to take an active interest in the schools. 2. The idea of training by action, by productive and civilizing labor, had advanced from theory into practice. The same means which are pointed out to man for his material support were now brought to serve as an effective instrument in his education; and, as the great mass of mankind are destined to maintain themselves by labor, the most effective means of civilizing and educating this large majority was thus discovered in labor. The chief point which remained to be considered was, how the leading classes of society, the employers, could be trained to recognize their duty, to educate and elevate morally the working classes, with the same interest with which they make use of hired labor to increase their own property. De Fellenberg indicated the way to this end also, and made the first step by the establishment of his educational institution, described above, for the higher classes.



## SPECIAL INSTRUCTION IN THE KINGDOM OF ITALY.

### INTRODUCTION.

ITALY, in the year 1848, comprised an area of 119,581 square miles, with a population of 24,695,720, distributed and organized as follows :

States.	Square Miles.	Inhabitants.
1. Kingdom of Sardinia, - - -	28,229	5,090,245
2. Lombardo-Venetian Kingdom, - - -	17,511	5,007,427
3. Duchy of Modena, - - -	2,073	486,458
4. Duchy of Parma, - - -	2,766	507,881
5. Grand Duchy of Tuscany, - - -	8,586	1,778,021
6. Papal States, - - -	17,210	3,006,771
7. Kingdom of Naples, - - -	43,127	8,704,472
8. Republic of San Marino, - - -	26	7,600
9. Principality of Monaco, - - -	43	6,800
Total, - - - -	119,581	24,695,720

After the war of 1859, in which the Austrians were defeated, Lombardy, having on 8,313 square miles, 3,104,838 inhabitants, was ceded to Sardinia, whilst the latter power (Sardinia) ceded Nice, having 1,633 square miles, and 543,535 inhabitants to France.

In the years 1860 and 1861, the kingdom of Italy was established, and Parma, Modena, Tuscany, Naples, and the greater part of the Papal States, with an aggregate of 12,708 square miles, and 2,446,683 inhabitants, as also the republic of San Marino, which, however, retained its peculiar constitution, were united with it.

In the year 1866, Venice, with 9,198 square miles, and 2,485,816 inhabitants, became part of the kingdom of Italy. The principality of Monaco was incorporated in the French empire in the year 1864.

Italy, in 1869, was composed of the following states :

States.	Square Miles.	Inhabitants.
1. The Kingdom of Italy, - - -	107,776	24,437,295
2. The Papal Dominion, - - -	4,502	692,106
Total, - - - -	112,278	25,066,401

More than one-third of the entire population (8,292,248) are engaged in agricultural pursuits; 3,923,631 in manufactures and commerce; 58,551 in mining; 542,293 in professions; 174,008 in the services of the Church; 147,448 in government and public employment; 242,386 in the army and navy. The population is distributed through 8,856 communes, of which 2,663 have less than 1,000, and 9 more than 100,000 inhabitants.

The general system is administered by a special Ministry of Public Instruction, and the technical institutions by the Ministry of Agriculture and Commerce. The latest statistics are as follows :

1. *Primary Instruction.* In 1866 there were 24,682 public primary schools, viz: 14,240 for boys, and 9,737 for girls; whilst the number of private primary schools was 5,435, viz: 2,726 for boys, and 2,341 for girls; making a total of 31,117 primary schools, viz: 16,966 for boys, and 12,078 for girls. Besides these, there were (in 1863) 2,803 evening and Sunday schools.

The total number of scholars in the public schools was 1,102,721, viz: 630,230 boys, and 472,491 girls; and in the private schools, 115,149, viz: 56,068 boys, and 59,081 girls. Total, 1,217,870 scholars: 686,348 boys, and 531,522 girls.

The number of teachers in the public schools was 26,019, viz: 15,478 male teachers, and 10,541 female teachers; whilst in the private schools there were 6,371 teachers, viz: 3,047 male teachers, and 3,324 female teachers; making a total of 32,391 teachers, viz: 18,526 male teachers, and 13,865 female teachers.

Thus the total numbers are as follows (of all the primary schools with the exception of evening and Sunday schools): 31,117 schools, 32,391 teachers, and 1,217,870 pupils. For the education of primary teachers there are 91 seminaries and model schools, and 44 conferences or institutes.

2. *Secondary Instruction.* There exist the following kinds: lyceums (*lycei*), and gymnasia (*gimnasi*), for the different grades of classical instruction; and the technical schools, technical institutes, and superior technical institutes, for scientific and practical instruction.

In 1868-1869 there were 78 royal lyceums, with 3,172 scholars; 14 assimilated lyceums, with 326 scholars; and 54 private lyceums, with 1,380 scholars; making a total of 146 lyceums, with 4,878 scholars. In the same year there were 103 royal gymnasia, with 8,223 scholars; 40 assimilated gymnasia, with 2,524 scholars; and 323 free gymnasia, with 9,783 scholars; making a total of 466 gymnasia, with 20,550 scholars. Total, 612 secondary classical schools, with 25,408 pupils.

There were 55 royal technical schools, with 5,868 scholars; 72 assimilated technical schools, with 4,594 scholars; and 138 free technical schools, with 6,495 scholars; making a total of 265 technical schools, with 16,955 scholars. There are 84 technical institutes, with 880 pupils; and 3 superior special institutes (at Milan, Turin, Naples), with 555 pupils. Total, 352 institutions, with 17,392 pupils. Total number of secondary technical schools was, in 1868, 964, with 42,800 scholars.

3. *Superior Instruction:*—20 universities, with 2,096 students of law, 1,320 of medicine, 987 of science, 71 of philosophy and literature, 9 of theology. With most of these universities there are special courses, some with one, others with two, three, or more, in all 47 courses, with 82 students in the notary course, 530 in the pharmaceutical, 16 in the surgical, 19 in the course of midwifery, 84 in the veterinary course. The total number of students in 1867-68 was 5,124 apporati, and 1,308 licentiates (only in the courses).

4. *Special and Professional Schools.* Of these there are:

Royal Institute of superior practical studies, at Florence, 138 students.

Academy of science and literature, at Milan, 27 students.

Royal superior technical institute, at Milan, 254 students.

School of medicine and veterinary surgery, at Milan, 58 students.

School of applied engineering, at Turin, 190 students.

School of medicine and veterinary surgery, at Turin, 98 students.

Royal superior normal school, at Pisa, 28 students.

Royal school of applied engineering, at Naples, 111 students.

Royal college of medicine and surgery, at Naples, 75 students.

School of medicine and veterinary surgery, at Naples, 71 students.

20 Nautical schools.

2 Mining schools, at Aosta and Agerdo, each with course of three years.

1 School of artillery and military engineering, at Genoa.

1 Military academy, at Turin.

1 School of infantry, at Parma.

1 School of cavalry, at Modena.

2 Marine academies, at Genoa and Naples.

6 Academies of music of the highest grade.

29 Schools of art.



## SUPERIOR TECHNICAL INSTITUTE AT MILAN.\*

The fame and excellent arrangements of the Technical Institute are in a great measure due to Professor Brioschi, the director, a celebrated mathematician.

It is divided into three schools, one for civil engineers, one for mechanical engineers, and one for architects, being authorized to confer certificates to those qualified for these careers and to teach in establishments of inferior degree. It is governed by a directive council consisting of the president of the Institute, the president of the Academy of Fine Arts, the president of the Technical Institute at Milan, of a delegate from the provincial board, one from the town corporation, and one from the Society for the encouragement of Arts and Trades (*Società d'encoraggiamento d'Arti e Mestieri*).

Applicants for admission must have finished the first two years of the faculty of mathematical sciences in one of the universities of the kingdom, and pass a successful examination in the two years' studies. Those wishing to enter at the second year must pass an examination according to the annual programme published by the directive council of the institute. Examinations also take place at the end of each year, and the pupils must pass these satisfactorily in order to be advanced. The examinations are both written and oral, and consist in the execution of some practical work, or in drawing of plans, as the subjects of the examination require. Certificates are granted after the examination at the close of the last year.

The annual matriculation fee is 100 liras, 40 liras additional being paid by students of chemistry engaged in practical exercises. Extraordinary expenses for geodetical investigations, or for visiting great manufacturing establishments, buildings, etc., are defrayed by the pupils. Auditors wishing certificates at the end of the year, pay 20 liras for each course to which they are matriculated.

By virtue of arrangements with the municipal corporation and the Society for the Encouragement of Arts and Trades, the Superior Technical Institute at Milan is entitled to the use of:

- a. The collections of natural history in the city museum.
- b. The collection illustrating chemistry and industrial mechanics of the society above mentioned.
- c. The chemical laboratory of the society.

It also possesses:

- a. The collection of machines and apparatus formerly constituting the technological cabinet of the Lombard Institute of Sciences, Belles-lettres and Arts, and a number of machines formerly belonging to the cabinets of the University of Pavia.
- b. A botanical garden in the Brera palace.
- c. A technical library.

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\* From Account of Technical Schools in Italy, furnished by Prof. Bonghi.

- d.* A collection or cabinet of technological physics.
- e.* A collection of geodetical instruments.
- f.* A collection of drawings and models for constructions.
- g.* A collection of ornamental and architectural drawings and models.
- h.* A laboratory of industrial chemistry.

We subjoin the programmes for the special schools, the figures denoting the number of hours per week.

*Special School for Civil Engineers.*

*Year I.* Theoretical mechanics, 4; geodesy, 2; topography, 2 during the first half-year; geognosy and applied mineralogy, 3; graphic statics, 3; chemical manipulations, 10 the first half-year; drawing, with application of descriptive geometry, 10 the first half-year, 20 the second; exercises in mineralogy, 1; exercises in statical drawing, representation of objects in rest, 3.

*Year II.* Technological physics, 3; construction:—civil constructions, 3; agronomy, 3; graphic statics applied to the science of constructions, 4; theorems of machinery, 2 the first half-year, 1 the second; theoretical and practical exercises in mathematics, 2 the first half-year; drawing for building, 20 the first half-year, 12 the second; topography and topographical drawing, 10 the second half-year.

*Year III.* Science of constructions: civil constructions, 2 the first half-year; earth constructions and roads, 3 the first half-year, 2 the second; fluvial and agricultural hydraulics, with hydraulic constructions, 3; agronomy and rural economy, 3; the elements of administrative law and agricultural jurisprudence, 3 the first half-year, 2 the second; railroads, 2; drawing for civil constructions, 8; drawing for road building, 4; practical architecture, 12 the first half-year, 9 the second; topography and geodesy, 10 the second half-year.

In order to pass from each class to the next higher, the student must pass an examination, and applicants for the diploma of civil engineer must, besides the examination on the subjects taught the third year, pass two general examinations, one consisting of some field operation; the other of a written solution of some practical question.

*Special School for Mechanical Engineers.*

*Year I.* Theoretical mechanics, 4; geognosy and applied mineralogy, 3; statical drawing, 3; topography, 2 the first half-year; chemical manipulations, 10 the first half-year, 9 the second; drawing and descriptive geometry, 10 the first half-year, 8 the second; exercises in mineralogy, 1; exercises in statical drawing, 3.

*Year II.* Technological physics, 3; science of constructions, 3; industrial mechanics and the conduction of waters, 4 the first half-year, 3 the second; theorems of machinery and machine building, 2; theoretical and practical exercises in mathematics, 2 the first half-year, 1 the second; technological chemistry, 9; drawing for constructions, 6; machine draw-



ing, 12; practical exercises in topography and topographical drawing, 10 the second half-year.

*Year III.* Fluvial hydraulics, 3; industrial mechanics and machine building, 4; railroads, 2; metallurgy, 2; machine drawing, 24.

At the end of each year is an examination on the subjects of the year, with the exception of the mathematics and theorems of machinery in the second year. Candidates for the diploma of mechanical engineer must draw a plan on some subject connected with industrial mechanics.

*Special School for Civil Architects.*

*Year I.* Rational mechanics, 4 the first half-year; topography, 2 the first half year; geognosy and applied mineralogy, 3; graphic statics, 3; mineralogical exercises, 1; exercises in statical drawing, 3; drawing with applications of descriptive geometry, 5; classical styles, distribution of edifices, reliefs, 10; elements of figure drawing, 6; copying of ornaments and water coloring, 8 the first half-year, 9 the second.

*Year II.* Technological physics, 3; science of constructions, civil constructions, 3; drawing for construction, 4; application of statical drawing to the science of construction, 4; styles of the middle ages, composition of plans, reliefs, 10; ornament copying and composition, 8; practical and topographical drawing, landscape drawing and water coloring, 6.

*Year III.* Elements of administrative law, and the jurisprudence of land, 3 the first half-year, 2 the second; drawing constructions, 5; drawing up plans, estimating, description of works, contracts, etc., 12; ornament copying and composition, interior ornament, furniture and utensils, 10 the first half-year, 8 the second; modeling architectural ornaments in clay, 6 the second half-year; landscape drawing and water coloring, 8 the first half-year, 6 the second.

Applicants for the diploma of civil architect must, besides passing the special annual examination of the third year, present a composition in architecture.

*Normal Course, designed for Professors of Natural History.*

*Year I.* Zoology; geology; mineralogy; chemical manipulations; exercises in mineralogy; scientific excursions.

*Year II.* Comparative zoology and anatomy; geology and paleontology; botany; exercises and scientific excursions.

*Year III.* Botany; geology and paleontology; agronomy; exercises in comparative zoology and anatomy, and scientific excursions.

Besides the above obligatory studies, supplementary instruction in mathematics is given at the institute, and in the current year 1869-70, the director of the astronomical observatory lectures on the "Theory of the errors of observation, with practical applications of the theory to scientific researches;" the professor of technological chemistry gives a course on "Chemistry as applied to agriculture;" the professor of industrial mineralogy, on "Chemical technology as applied to the art of building;" the director of the museum, a course on the "Zoology of the inferior animals, with the principal applications."

## NORMAL TECHNICAL INSTRUCTION.

There is no special normal technical school, and no special title conferring the right to teach or to enter those competitive examinations by which professors in technical schools are chosen. The Superior Technical Institute at Milan can grant diplomas testifying that the holder is qualified to teach in any of its three special schools, which is also the case with those who hold diplomas of a university faculty of mathematics and the two schools of application at Turin and Naples. As regards the other branches taught at the technical institutes, candidates become qualified at two other institutions dependent upon the Department of Agriculture and Commerce, viz: the Industrial Museum at Turin, and the Superior School of Commerce at Venice. The former combines a permanent industrial exhibition with a school for the application of sciences to the industries, more especially to chemical industry, and professors of physics, chemistry, and technology, must obtain their diplomas there. The latter, which is maintained at the expense of the province with a State subsidy, is the institution at which aspirants to professorships of political economy, accounts and commercial law, and geography, must obtain diplomas.

In regard to professors in Naval Institutes, there is a project under consideration to raise the normal instruction intended for them into a school of shipbuilding, to be located at Genoa.

A remodeling of the Agricultural Institute at Milan is also debated, so as to include in it a normal institute for professors of agronomy. Professors of literature are sought among the graduates of the university faculties of belles-lettres and the normal schools, whence also are sought teachers for technical institutes.

It will appear from this detail, that normal technical instruction in Italy has not yet received an efficient organization and a thorough scientific and practical course of study. The great number of institutions tends to hinder progress in this particular. Their development has been so rapid, and the demand for professors consequently so great, that the nominations have been made without due care, which is one of the reasons why technical instruction, especially as regards literary and general culture, is in a very unsatisfactory condition, and the country does not realize the advantages which the large disbursements, and the general favor with which these schools have been regarded, would lead us to anticipate.



## SCHOOL OF NAUTICAL INSTRUCTION AT GENOA.

The course of instruction in the Nautical Institute at Genoa embraces :—I. Nautical Astronomy and Navigation; II. Mechanics and Steam Engine; III. Maritime and Commercial Law; IV. Geography and Meteorology.

*I. Nautical Astronomy and Navigation.*

*Introduction*: 1. Nautical art in general; different sciences attached; need of varied knowledge for captains; special applications of mathematics to navigation. 2. Method to be pursued in carrying on nautical studies.

*Plane Navigation*: 3. Figure and dimensions of the earth; equations in equal spheres of a circle traced on the same. 4. Methods for determining the course of the ship; the compass. 5. Demonstrations of the principles on which the solution of problems of navigation rest, reduction tables. 6. Given two of the four quantities, how to find the other two in determining the position of a ship. 7. Reduction of a straight course; degree of confidence to be placed in results. 8. Maritime charts; how constructed; resolution of problems.

*Nautical Astronomy*. 9. Elementary notions of astronomy; special objects in teaching this science to seamen. 10. Astronomical tables in use among different nations, and how to use them. 11. Instruments for reflexion, and principles of construction; verification, rectification, and use of the sextant, octant, and artificial horizon; corrections to be made on the heights and angular distances observed; depression; refraction; parallax, semi-diameter. 12. Examination of the principal problems relative to the measure and transformation of time. 13. The chronometer; absolute state of the chronometer; diurnal variations; comparison; use of chronometers. 14. Compass; its construction and verification; determination of the declivity; tables of deviation; correction bars. 15. Different methods for determining the latitude and longitude at sea. 16. The tides, their fundamental theory; calculations regarding them. 17. Hydrographic charts; topographical instruments, and different projections.

*II. Mechanics and Steam Engine.*

*Introduction*: 1. Necessity for the use of mechanics and physics for the shipmaster, naval constructor and machinist. 2. Method of giving such instruction to seamen.

*Mechanics*:—Motion considered geometrically; composition; decomposition. 3. Transformation of motion. 4. Force; composition and decomposition of force; equilibrium. 5. Center of gravity, and how to find it; application of the same, on the theory of the ship. 6. Theory of simple machines; principal machines. 7. Principle of force. 8. Blows. 9. Resistance of materials; experimental elements of resistance, and elasticity of the principal substances in use in naval construction. 10. Mechanic of fluids; demonstrations of its principal theorems; application of the same to the stability of the ship.

*Steam Engines*:—11. General notions on steam; mechanical element of heat; thermometers; tension; expansion; condensation of steam. 12. Steam engines generally; examination and description of its organs, and its different forms and applications. 13. Marine steam engines, and different systems on which they are constructed. 14. The boilers and their different types. 15. Combustibles and their different kinds. 16. Different systems of propulsion. 17. Mixed Navigation. 18. Historical summary of the origin and progress of machine and steam power.

*III. Maritime and Commercial Law.*

*Introduction*: 1. Necessity of general culture to shipmasters; study of the native tongue; foreign languages; history; methods of gaining such instruction. 2. Necessity of the study of public maritime and special law, and commercial law; method of giving such instruction.

*International Public Maritime Law*: 3. The sea, and the laws by which it is governed; freedom of the sea; restrictions to this principle. 4. International maritime jurisdiction; treaties; reciprocity; consular agents. 5. War, embargoes and reprisals; letters of marque; capture; neutrality; blockade; contraband of war. 6. The latest modifications.

*Internal Public Maritime Law:* Territorial sea; harbors and shores; administrative division of the boundaries of states, and docks. 9. Laws applicable to wooden and iron ships, sailing and steamships. 10. Nationality of the ship. 11. Law applicable to the *personel* of seamen. 12. Customs, laws, sanitary and police, as regards navigation. 13. Wrecks and recovery. 14. Maritime crimes and penal mercantile jurisdiction.

*Private Commercial Maritime Law:* 15. Ownership of ships; privileges of ships. 16. Contract of freight; insurance and bottomry bonds; averages; jettison and abandonment. 17. Duties and responsibilities of the master toward the freighter, the shipper, the crew, and the passengers. 18. Legal relations arising from commercial operations; bills of exchange; partnership and agency.

#### IV. *Geography and Meteorology.*

*Introduction:* 1. Necessity of this knowledge to seamen. 2. Relations between geography and meteorology. 3. Historical development. 4. Fundamental principles of geography, astronomy, and mathematics, and methods of instruction.

*Physical Geography and Meteorology:* 5. Fundamental principles of geology; physical configuration of the earth; forces which determine the formation of continents and islands; extension of lines, &c. 6. Description of different parts of the globe. 7. Physical geography of the sea; its extensions, divisions, depths, soundings, temperature, phosphorescence, colors, tides, currents, storms. 8. Descriptive hydrography—oceans, their divisions and dependencies; the rivers and lakes in different parts of the globe. 9. The atmosphere—its extension, temperature, and the thermometer; different thermometric scales; atmospheric density and pressure; the barometer—different barometric scales; the winds—general, periodical, variable; hurricanes; storms; law of storms; watery luminaries and electric meteors; signs and forecasts of the weather. 10. Magnetism—magnetic action; declension of the magnetic needle; the compass. 11. Geographical distribution of minerals, plants, and animals, utilized by man. 12. Man as a geographical modifying agent.

*Political Description:* Statistical and commercial geography. 13. Divisions, population, wealth, finances, commerce, and other statistical data of different states, in different divisions of the globe.



## SYSTEM OF TECHNICAL SCHOOLS.

In pursuance of the same general policy which led to the establishment of Real Schools and Trade Schools in Germany, and the system of Secondary Special Instruction in France, the framers of the general school law for Italy in 1859, provided for a separate classical training for youths whose taste and leisure enabled them to take a more general and generous culture, or who were destined for professions in which philological discipline and acquirements were a necessary or highly desirable preparation; and at the same time inaugurated a system of scientific and practical schools for that larger class to whose hands the industries of the country are committed. This branch of the general system is not fully developed, but a good beginning has been made in the right direction.

## II. SECONDARY TECHNICAL SCHOOLS.

The conception of the scope of technical instruction in the law of 1859, is very broad, but the provisions made are not sufficiently definite. Its aim is defined to be, "to give young men wishing to embrace a special career in the public service, or to devote themselves to any mechanical or commercial pursuit, or to the cultivation of land, a proper education, both general and special." It is evident that these words will cover an infinite variety of schools.

To supply such instruction, the law established a system which was certainly insufficient; although, under the impulse of the State, communities taking the initiative, many institutions of a new form and with more of science in their curriculum, were added to those previously existing.

The framers of the law of 1859, contented themselves with determining that technical instruction shall be of two grades, each grade being completed in a three years' course; that instruction of the first grade is to be given in so-called technical schools (*scuole tecniche*), and that of the second grade in the technical institutes (*istituti tecnici*); that one technical school shall be maintained in the chief town of each province; that technical institutes shall be opened "as their necessity shall be felt," in those towns which are the centres of industrial and commercial activity; that the costs of technical schools shall be defrayed by the communes, the state bearing one-half only of the whole sum paid for the salaries of teachers; that the cost of technical institutes shall be shared by the provinces, whose part it is to supply scientific apparatus and to pay the salaries of the teachers—the state, giving the same assistance as in the case of the technical schools—and the communes furnishing the premises and furniture.

The same law enacts that technical schools, and technical institutes, shall be kept distinct from the gymnasiums and lyceums, and that the simultaneous management of both shall never be entrusted to the same persons. The law, then, admits in no manner of an identification of these

two classes of schools, not even of the first three gymnasium classes, with the three classes of the technical school.

With regard to the subjects of instruction, the following provisions were made for technical schools of the first grade :

1. Italian. 2. French. 3. Arithmetic and accounts. 4. Elementary algebra and geometry. 5. Drawing and calligraphy. 6. Geography and history. 7. Elements of natural history, physics, and chemistry. 8. Notions concerning the duties and rights of citizens.

In technical institutes, the following branches are taught :

1. Italian literature. 2. History and geography. 3. English and German. 4. Institutes of administrative law (*diritto amministrativo*). 5. Political economy. 6. Details upon commerce. 7. Social arithmetic. 8. Chemistry. 9. Physics and elementary mechanics. 10. Algebra, plane and solid geometry, rectilinear trigonometry. 11. Drawing and elements of descriptive geometry. 12. Agriculture and natural history.

It is intended that so far as the natural and economical situation of the state may allow, instruction in all these branches shall be of a practical as well as theoretical character. Moreover, as it is not necessary that all the scholars pursue all the studies, the courses are divided into sections, the studies for each section being designated with a view to their utility in particular pursuits, the number of the sections, and the studies in each, varying according to the special needs of each province.

On this basis has the fabric of technical instruction in Italy been founded and carried up thus far. It might appear that by the provisions of this law, this instruction is to be general during the course of the technical school, and special in that of the institute. This interpretation owes its origin to the fact that in 1861 the direction of the technical course was divided between the minister of public instruction, to whom was entrusted the technical schools, and the minister of agriculture and commerce, to whom were assigned the technical institutes, a measure which widened more and more the separation between these two institutions, originally intended to connect.

#### I. TECHNICAL SCHOOLS.

On the 19th of September, 1860, regulations were issued for the better distribution and disposition of the branches prescribed by law; which regulations have been by separate decrees put in force in all the states, except Tuscany, where the law and by-laws concerning technical education, published by the provisional government on March 14th of the same year, are still in force, and do not differ materially from the general system.

The following is the curriculum of the technical schools according to the regulations of September 19th, 1860, with the number of lessons per week assigned to each :

*First year.* Italian, geography, and history, each five lessons of two hours. Arithmetic, calligraphy, and ornament drawing, each five lessons of one hour.

*Second year.* Italian, geography, history, and plane and solid geometry, each four lessons of one hour and a half. Linear and ornament drawing, two lessons of one hour and a half. French, five lessons of two hours.



*Third year.* Italian, geography, history, and notions on the rights and duties of citizens, each three lessons of two hours. Algebra and elementary mechanics, two lessons of one hour and a half. French, and accounts, each four and a half hours weekly, in three lessons. Architectural drawing, two lessons of one hour and a half. Physics and chemistry, four lessons of one hour.

If the law of 1859 had been strictly adhered to, the state should have rendered assistance only to such technical schools as were established in the chief towns of the provinces, and many schools which had been opened in Piedmont under the provisions of the anterior law of May 11, 1858, not in such chief towns, would have been compelled to close their doors. The provisions of this anterior law were therefore declared to be in force, and a subsidy was promised by the State to all communes endowed with technical schools. On the other hand, the provisional government of 1860, while promulgating the law of 1859, did not completely provide for the execution of that part of it concerning the expenditure, and the proportion thereof to be borne by the communes and the State. In Sicily a clause was added to the law by which technical schools were to be entirely maintained by the State. Besides, technical schools did not, in all places, assume the character of State institutions; that is, institutions the nomination of whose teachers is in the hands of the State, which bears half the expense of teachers' salaries. In the province of Emilia, viz: in the ex-duchies of Parma and Modena, and the Romagna, these schools preserved their communal character, by a decree of January 21, 1860, although subsidised by the State; that is, their administration and the appointment of teachers belonged to the communes. It has been found impossible as yet to do away with these irregularities, and to render the system uniform. Parliament has been content with meeting the expenses for developing the system of technical instruction as demands were made, and the ministers have, by means of ordinances, regulated the distribution of these funds among the communes wishing to open new schools.

Technical schools are, therefore, with respect to the authorities on which they are dependent for their administration, divided into government, assimilated, and free. Government schools are subsidized, managed and directed by the State. Assimilated schools are those managed and directed by communes, with a strict adherence to the rules governing State schools with respect to the nomination of teachers, the amount of their salaries, and the distribution of studies, hours, etc. Finally, free or non-state schools are those managed by communes or provinces, on whatever system may seem best to themselves, and governed by their own officials.

The government technical schools were attended in the scholastic year 1868-69, by 5,868 pupils, as follows: Class I—students, 2,427; auditors, 154. Class II—students, 1,911; auditors, 126. Class III—students, 1,133; auditors, 117. The number of the schools was 55.

Assimilated schools to the number of 72 were attended as follows: Class I—students, 1,861; auditors, 89. Class II—students, 1,540; auditors, 80. Class III—students, 931; auditors, 93. Total, 4,594.

The free schools reached the high number of 138, and were attended by

6,495 pupils: Class I—students, 2,721; auditors, 223. Class II—students, 1,971; auditors, 171. Class III—students, 1,255; auditors, 154.

The total number, therefore, of students in the first grade of technical instruction was 16,957, of which 15,750 were regular students, and 1,207 auditors, divided among the three classes as follows: Class I—students, 7,609; auditors, 466. Class II—students, 5,422; auditors, 377. Class III—students, 3,319; auditors, 364.

An auditor here, as elsewhere, signifies one who is pursuing the studies of the course without having submitted to the regular examination for matriculation, and consequently is not allowed to enter the examinations for advancement (*promozione*), nor for a license or degree (*esame di licenza*).

## II. TECHNICAL INSTITUTES.

The law of 1859 gave the appellation of technical institutes to those educational establishments wherein technical instruction of the second grade was to be given. It appeared, however, to enact that instruction of this grade should be as special as that of the first grade was general, directing that the technical institute be divided into special sections, as already described. It was attempted to realize this provision by the regulation of 1860, while technical instruction still appertained to the Department of Public Instruction. The institute was divided into four sections—the administrative and commercial, the agricultural, the chemical, the physical and mathematical sections. Contrary to the dispositions of the law which had fixed the duration of the course at three years, it was established that two years should be spent in the first three sections, and three in the fourth. The institute might be incomplete, or complete, that is, provided with all four sections, in which case the full corps of instructors included ten professors, three institutors (*istutori*) and supplementary teachers, with four assistants, the chairs being as follows: 1 professor of Italian literature, history, and geography; 1 of political economy and the history of commerce and industry; 1 of physics; 1 of general chemistry, and agricultural chemistry, with assaying; 1 of technological chemistry; 1 of natural history and the rudiments of the elements (*materie prime*); 1 of agriculture; 1 of mathematics; 1 of mechanics and the drawing of engines, and 1 of drawing; a supplementary master of English and the other modern languages; 1 of the elements of commercial and administrative law, and 1 of accounts; an assistant at the cabinet of physics, at the cabinet of general chemistry, and at the cabinet of natural history.

On November 28th, 1861, the technical institutes passed into the Department of Agriculture and Commerce, which had been established without well defined functions about eighteen months previously, the reason assigned for the transfer being that the function of the Department of Public Instruction was to make provisions for general culture, while that of the technical institutes is to give a special and final practical training, since no school but the workshop is to succeed them.

The Department of Agriculture and Commerce entered immediately into



activity; in 1862 a Superior Council of Technical Instruction was created, and charged with the same functions as those which the law of 1859 assigned to the Superior Council appointed to superintend all the other branches of public instruction. This new Council, which discharged its functions gratuitously, proved to be slow, and accomplished its work quite inefficiently.

Meanwhile, during the first four years of its existence, the Department of Agriculture and Commerce did not introduce any changes into the regulations of 1860. Experience showed that two years was an insufficient period for the sections of agriculture and commerce, nor did the three years devoted to physics and mathematics better meet the demand. The section of chemistry remained without students. Notwithstanding these drawbacks, which were corrected in some way or other, the number of government institutes was on the increase. In 1861-62 only six existed; at the close of 1865 the number of government, provincial, communal, and private institutes was 59, 33 being government institutes, 13 assimilated, and 13 non-state, of which last 5 were private establishments.

In October, 1865, the Department of Agriculture and Commerce issued new regulations, based on the experience of the institutes, calculated to give, so far as the administration was concerned, greater freedom to the institutes, but to restrict more and more the liberty of private instruction.

The title of government institutes was continued to those aided by the government, and which alone had the power to grant the regular diploma, after due examinations and the exhibition of all legal certificates. In order that a non-government institute may obtain this privilege it must become assimilated, that is, it must conform to the rules governing state institutions.

Each section of the institute, according to the regulations, imparts special instruction for a particular career or profession, in mechanical or commercial life, navigation or agriculture. In regard to expenditures, the salaries of masters was to be at the charge of the state, the premises and furniture at that of the commune, and the apparatus, engines, books, &c., at that of the province. Similarly, the state, the province, and the commune, were to have an equal share in the superintendence of the schools, through a local committee of supervision, consisting of four members; the first three being chosen by the provincial council, the communal council, and the chamber of commerce in union, the last two by the prefect of the province where the institute is located. The functions assigned to this committee in the administration and direction of the institute are very numerous. In regard to the curriculum, the local committee is called upon to act on proposals from the council of the institute in regard to the arrangement of hours, rules of discipline, examination subjects, text-books, detailed programmes, etc. The council of the institute, whose office it is to make proposals on such matters, consists of all the teachers, presided over by the *Præses*, or president of the institute itself. The natural result, whether for good or for evil, of this exercise of influence by the teachers is, that

there is much diversity among the technical institutes in regard to these matters.

The sections into which it was the main object of the regulations of 1865 to divide technical instruction were as follows:

1. Agriculture and land mensuration. Pupils receiving the certificate of license after due examination, were entitled to the appellation of "expert surveyor," and, if versed in sylviculture, to the additional title of "expert forest surveyor." They were furthermore acknowledged as "expert agronomists," could be admitted to the royal schools of veterinary medicine, and if acquainted with Latin, to the university course of chemistry and pharmaceutics, and enjoyed preference in the nomination to vacancies among the "forest guards," or the assistants in public works.

2. Commerce and administration. Those obtaining a license from this department received the diploma of "experts in commerce."

3. Mechanical construction, giving the title of experts in mechanics and construction.

4. Mercantile marine. Certificates granted in this section give their possessors the right to present themselves at the examinations prescribed, in order to obtain any of the following degrees from the minister of the navy: 1. Navigator of the high seas (*Capitano di lungo corso*). 2. Naval engineer of first class. 3. Ship builder of first class. 4. Captain of coasting vessels (*Capitano di gran cabotaggio*). 5. Naval engineer of second class. 6. Master. 7. Ship builder of second class.

5. Mineralogy and metallurgy. Licenses granted in this section give the title of experts in mineralogic and metallurgic industry.

6. Accounts, with the title expert accountants. Public offices are very often conferred upon expert accountants, whether government, provincial, or communal, and particularly places in savings banks.

7. Chemistry as applied to manufacturing and other industries.

8. Mechanical industries.

9. Physical and chemical industries.

Diplomas in the last three sections confer the title of experts in industry, with specifications of the particular branch to which the student has directed his attention theoretically and practically. The various branches are as follows: (*a*) tanning and dressing skins; (*b*) cotton and woolen manufactures; (*c*) industrial engraving and printing; (*d*) working in fat, acids, and soaps; (*e*) preparation of pharmaceutical substances; (*f*) wool and flax manufactures; (*g*) lithological industry; (*h*) silk and velvet manufacture; (*i*) science and art of coloring; (*j*) manufacture of scientific implements; (*k*) telegraphy; (*l*) manufacture of sulphur.

Such were the dispositions made by the regulations of 1865. But if they were carried out and found useful in respect to the administrative department, the same can not be said of those concerning the division of the institute into sections. Of the nine sections prescribed by the said regulations, only five were actually established, viz: the sections of agriculture, of commerce and administration with the addition of the section of ac-



counts, of physics and mathematics or mechanics and construction, of mineralogy and metallurgy, and of mercantile marine. But the number of these sections in each institute varies according to local circumstances.

In 1866, the section of naval education received a separate organization, being divided from the other sections of the institute. By the common consent of the Department of Agriculture and Commerce and the Department of Marine, naval instruction of the first degree was given in naval schools, that of the second degree by schools of mercantile marine. In the former is granted the title of *Capitano di gran cabotaggio*—ship builders or engineers of the second class—after due examination, which may be general for all degrees, or special for each special degree. The latter give the title of *Capitano di lungo corso*—first class ship builders and first class engineers.

Examinations in technical branches are, according to the regulations of 1865, of three kinds, each being both written and oral, viz: examinations for (1) admission to any class of the institute; (2) advancement from one class to the other; (3) license at the close of the course. A natural consequence of confiding the technical institutes and technical schools to different departments is, that examination before being admitted to the former is required of all candidates, whatever their previous history, although the regulations exempt the graduates of government or assimilated technical schools from such examination. The result is that many of the graduates of the latter do not present themselves, and that many of the candidates have not attended the technical school. Committees for the entrance examinations are appointed by the local municipal boards; those for the examinations for advancement (*esami di promozione*) are composed of the teachers of those subjects upon which the examinations are held. The presiding officer in both is the *Præses* of the institute. In 1868 a change was made in the mode of the examination, similar to that made the preceding year in the lyceum examinations for a license. According to the regulations of 1865 the license examinations, both oral and written, were to be held in every state institute by a local committee, consisting of the professors of each section respectively, with the addition of those persons whom the local Board of Vigilance might deem proper to add. This committee was to be divided into two sections, the former examining in Italian literature, geography, history, French, and English or German, with similar general subjects included in the programme of the examinations, the latter examining in those special subjects completing the programme of the various sections of the institute. But after 1868 the right of examining the written answers to the examination was given to a Central Committee or Board formed from the Department of Agriculture and Commerce, the rest of the examination being assigned to local committees, under the superintendence of one of the members of the Central Board. There are at the examination of both the summer and autumn session three themes selected from the programmes of instruction, as prescribed by the government, by the Central Board, the sealed package containing them being opened by

the delegates or commissioners of that Board in the presence of the candidates and the local committees. The candidates can choose among these themes.

Each examiner can give ten points, and an average of six points is the standard of approbation, but a rank of only five points on any one subject causes the candidate to be rejected, as does also a stand under six on three separate subjects, although candidates who fail on only three points are allowed another examination (*esame di riparazione*) when the autumn session is held.

The central board has discharged its duties well during these two years, the first of its existence, or at least has not been subject to those dissensions which have so much impeded the efficiency of the committees of the lyceum examinations for license, and which ought to have resulted in the dissolution of these last and the appointment of new committees by the Superior Council of Public Instruction from among its own members, which should be directed not to reject or approve of the candidates, but to give prizes to the most deserving, and to inspect the action of the examiners by giving the written answers a careful examination some time in the year. The chief cause of the difference in the results in the two cases is, that the local examination committees for the technical institutes are composed of professors connected with them, while the committees for the lycæums are composed of persons wholly unconnected with these institutions. Therefore the professors declared themselves hostile to the Classical Central Examination Board, but had no reason for assuming such an attitude to the Central Technical Board.

#### *Statistics of Technical Institutes.*

The number of technical institutes has rapidly increased, being 59 at the end of 1865, and 84 at the close of 1869. Of these 47 were government institutes, 35 communal and provincial, and two private. The number of students has also increased, being 880, of whom 600 were in state institutes, 142 in the assimilated, and 138 in the free; agronomy and land mensuration had 40 sections, with 350 candidates; commercial and administrative knowledge, 32 sections, 220 candidates; mechanics and construction—for a license, 24 sections, 126 candidates; for diploma, 12 sections, 51 candidates; mineralogy and metallurgy, 2 sections, 8 candidates; mercantile marine—*Capitani di lungo corso*, 5 sections, 53 candidates; *di gran cabotaggio*, 8 sections, 52 candidates; ship builders of first class, 5 sections, 11 candidates; engineers, 2 sections, 3 candidates; total, 130 sections, 880 candidates.

The results were as follows: approved—257 from state institutes; 65 from those assimilated; 58 from those free; total, 380. Deficient in not more than three subjects—280 from state institutes; 61 from those assimilated; 58 from those free; total, 399. Rejected—63 from state institutes; 16 from those assimilated; 22 from those free; total, 101.



*Results arranged according to sections.*

	Approved.	Deficient in not more than three subjects.	Rejected.	Percentage of Approbations.
Agronomy and land measuring,	132	166	52	38
Commercial and administrative knowledge,	93	108	19	42
Mechanics and construction—				
<i>a.</i> License,	47	59	20	38
<i>b.</i> Diploma,	20	32	5	35
Mineralogy and metallurgy,	2	5	1	25
Mercantile marine—				
<i>a.</i> <i>Capitani di lungo corso,</i>	46	7	—	87
<i>b.</i> “ <i>di gran cabotaggio,</i>	28	20	4	54
<i>c.</i> Ship builders of first class,	9	2	—	82
<i>d.</i> Engineers,	3	—	—	100
<b>Total,</b>	<b>380</b>	<b>339</b>	<b>101</b>	<b>43</b>

The comparison of the ages of the candidates is curious and instructive, showing that pupils of the technical institutes are not recruited in a regular manner. There were 5 candidates of 15 years of age, 35 of 16, 85 of 17, 147 of 18, 164 of 19, 134 of 20, 107 of 21, 50 of 22, 43 of 23, 26 of 24, 21 of 25, 51 above 25, and 12 of unknown age.

*Examination Fees.*—Instruction in technical schools was, according to the law of 1859, gratuitous as in elementary schools, but a by-law of January 3d, 1867, fixed the following fees: 5 liras for admission examination, 8 for annual matriculation, and 10 for license examinations. Pupils of the technical institutes paid fees from the first. These last were fixed by the law of January 3d, 1867, at 30 liras for admission examinations, 40 for annual matriculation, and 60 for the license examinations.

*Appointment and Salaries of Professors.*—Titular professors in technical schools and institutes are by law chosen by competition, under the same rules as those which regulate the nominations to professorships in the gymnasium and lyceum. Owing to the haste which prevailed when these establishments were opened, the competitive examinations were dispensed with, and the teachers are, therefore, with some exceptions, much inferior to those needed, and which would have been obtained by a *concour*.

Technical masters receive the same salaries as those allowed to professors in the gymnasiums and lyceums, but these vary, according as the establishment belongs to the state, or to the commune, or to individuals, or an association, different contracts being made in different circumstances.

## SUPERIOR TECHNICAL INSTRUCTION.

It was probably the intention of the framers of the law of 1859, to entirely separate classical and technical education, the former being completed by the university, the latter by superior technical institutes. But the law has not effected this object, as it has merely ordered that a Royal Superior Institute for technical education shall be opened at Milan, at the expense of the State, with the addition of a school of application (*scuola*

*d'applicazione*) for civil engineers, and another for land surveyors; and that teachers in superior technical institutes are to enjoy the title, rank, and salary of university professors.

Though such a regulation appeared to establish a superior technical training differing from university education, it, on the contrary, aimed at the opposite in the establishment of a school for engineers in Turin, which was also acknowledged as a department of the university faculty of physical and mathematical sciences.

It is natural that with such an ill defined basis, there should remain much doubt as to the proper method of combining superior technical training with middle and university education. Pupils are admitted to the university faculty of mathematics, on presenting a certificate of license from the third year of the physical and mathematical section of the institute, as equivalent to one from the classical lyceum. The result is, that the former course is preferred to the latter, there being two years less required. On the other hand, no pupils are admitted to the courses of the Superior Technical Institute who have not previously finished the first two years of the university faculty of mathematics, and undergone special examinations on subjects connected with it. Pupils may thus pass from a technical institute into a university faculty, and not into a superior technical institute. Meanwhile these two years in the faculty of mathematics might well be compressed into one, for those intending to embrace any of those careers for which the technical institute gives preliminary training; but there is no existing institution where this year could be thus employed. The municipal corporation of Milan, which has made a proposition to open such a school at its own expense, encounters serious difficulties, while the mathematical faculties of the universities oppose vigorously this step, as calculated to take away a large number of their present auditors, an opposition that is seconded by the ministry of public instruction, to which department the superior technical schools are assigned.

There are at present in Italy three technical institutes of the superior grad, viz: the Royal School of Application for Engineers at Turin, the Royal School of Application for Engineers at Naples, and the Superior Technical Institute at Milan.



## SPECIAL INSTRUCTION IN MUSIC.

Italy abounds in special schools for instruction in music, supported or aided by public appropriations, viz., at Milan, Parma, Florence, Naples, Palermo, and Rome, of several of which we have brief accounts :

## ROYAL MUSICAL INSTITUTE AT FLORENCE.

The *Royal Musical Institute* at Florence was established to give public and gratuitous instruction in music in every branch of the art. It is maintained by a grant from the state, (in 1866, of 40,694.70 lire,) besides the use of the building, which is state property. The pupils are of both sexes, are admitted on examination, and receive a diploma of proficiency at the close of their course. The Institute is directed by the President, whose services are unpaid, assisted by three professors who are not instructors in the Institute, and who constitute the Council of Management. The Secretary has charge of the financial administration. The following are among the printed regulations of the Institute :

1. *Schools or Classes.*

- (1.) History of music and æsthetics as applied to music. This class has a master with the title of professor.
  - (2.) Harmony, counterpoint, and composition. A master with an assistant.
  - (3.) Accompaniment from a figured bass and from score. Has a master.
  - (4.) Singing, vocalization, theatrical instruction, elocution, and deportment. Has a master and assistants when necessary.
  - (5.) Elementary instruction, reading music, and solfeggio. The pupils are instructed from the first principles to the practice of solfeggio. A master and assistants.
  - (6.) Organ, to enable the pupils to accompany the singing from notes. A master.
  - (7.) Pianoforte, for professional pianists. A master.
  - (8.) Secondary pianoforte, to enable singers to accompany themselves.
  - (9.) Violin and viola.
  - (10.) Violonecello.
  - (11.) Double bass. In this class the scholars are taught from the groundwork of their respective instruments up to the perfect execution for an orchestra or a quartet.
  - (12.) For wind instruments of wood.
  - (13.) For ditto of brass.
- In these two classes the pupils are taught from the rudiments up to perfect orchestral execution.
- (21.) A choral school is attached to the Institute, where the people can be instructed in choral singing. It does not form an integral part of the institution, nor is it a necessary step to the other schools. The instruction is gratuitous in this as in other schools.
  - (23.) The instruction in both schools is gratuitous.

2. *Masters.*

- (24.) The masters and sub-masters are all appointed by Government, on the recommendation of the president.
- (25.) The masters are responsible for the good regulation of the classes to which they are attached, the arrangements of which have been settled by them with the president.
- (27.) The masters and sub-masters must assist at the examination of their pupils.
- (28.) The sub-masters and the assistants are chosen by the president from amongst the better pupils; their post is gratuitous but if they have held it for a year they are usually paid something.

3. *Pupils.*

- (29.) The conditions on which the pupils are admitted are—Morality, good health, and natural aptitude. The age varies according to the nature of the

instruction sought, but is never under nine years. Full knowledge of reading and writing and the elements of arithmetic are necessary. Special conditions for admission to each school are laid down in general rules. The pupils are admitted provisionally, and if they pass the examination are drafted into the Institute.

(31.) Fitness to pass from one class to another, or from one school to a superior one, is determined by the examination called "passaggio." After two failures a pupil is dismissed from the Academy.

(32.) To have the right to call themselves pupils of the Institute, it is necessary, at the completion of the studies, for the pupils to go through a final examination for a license; if this is well passed they are declared "Accredited Pupils of the Institute," and obtain their diploma. This gives them a preference, *ceteris paribus*, over others in competitions for any public employment.

(33.) The pupils must behave with respect both to their colleagues and their masters, to whom they must pay implicit obedience, and conform to all the rules of the establishment.

(34.) Flagrant and repeated faults amongst the pupils are punished by expulsion on the sentence of the president.

#### 4. Concerts.

(35.) During the scholastic year such of the pupils as are considered competent, practice concerted music. This practice is independent of the usual classes, and is as follows:—For bowed instruments and for quartet practice, under the direction of the violin master; for wind instruments, and for the execution of good harmony, under the alternate supervision of the master of these schools; for singing in concert with or without full orchestral accompaniment.

(36.) Public concerts by the pupils are given at stated periods and at the end of the academical year.

#### ROYAL CONSERVATORY OF MUSIC AT MILAN.

The *Royal Conservatoire of Music* at Milan is maintained by the State, and offers a complete course of instruction in music, and in several associated literary branches. The musical instruction is directed by 29 professors and by about 30 teachers, selected from among the best pupils of both sexes. For the literary branch there are seven professors. There are two other professors, one of deportment, pantomime, and ballet, the other for drill. There are, besides, a librarian and copyist, a tuner of the piano, a cashier and accountant, two inspectors, a secretary, seven inspectors for the pupils, four servants, a carpenter and decorator, a messenger, two porters. These persons (except the teachers of both sexes, who receive no payment for their services) cost the Government yearly 78,600 lire.

The Conservatoire instructs annually about 240 pupils of both sexes.

Each year the Conservatoire turns out from 12 to 15 finished pupils.

To the pupils of both sexes who distinguish themselves the most at the yearly examinations is granted from year to year a monthly pension, arising from an endowment of 12,720 lire.

For all the other requirements of the establishment the State assigns 19,868.90 lire annually.

The fee which the pupils pay in each year is about 4,000 lire.

#### ROYAL COLLEGE OF MUSIC AT NAPLES.

The *Royal College of Music* at Naples, was founded in 1809, by Murat, when he became King of Naples, after the model of the Academy at Paris, by consolidating three institutions, which were in feeble existence at the time, under the directorship of Zingarrelli. There are 100 pupils, whose entire expenses (board and instruction,) are paid, and about the same number of day scholars, whose tuition is free. The resident pupils are divided into 15 classes, for musical instruction, under 20 professors, besides 7 professors who are entrusted with their literary studies. Toward the annual expenses, the state appropriates 125,197 lire, and the avails of certain endowment scholarships. Many pupils of this college have attained high eminence as composers, performers, and professors.



## SPECIAL INSTRUCTION IN PORTUGAL.

### INTRODUCTION.

THE Kingdom of Portugal, on an area of 36,510 English square miles, in 1866 had a population of 4,351,519.

The total annual expenditure for the financial period 1863-64, amounted to 16,910,354,056 milreïs (1 milreïs = \$1.12).

The superintendence of public instruction is under the management of a superior council of education, at the head of which is the secretary of State for the home department, and which holds its sittings at Coimbra. Public education is entirely free from the supervision and control of the church.

1. *Elementary Schools.* In 1868, according to official returns, there were 2,845 elementary schools, attended by 107,131 pupils. For the support of these schools the state gave 878,980 florins; besides which, contributions were made by communes, corporations, and parents. 27,822 pupils were returned in private schools.

2. *Secondary Schools.* Of these there were 21 public lyceums, with 4,170 scholars; 126 private schools, with 3,496 scholars; and 12 private schools exclusively for females, with 389 scholars.

3. *Superior Education.* The University at Coimbra, with five faculties, has 45 professors, and an average of 900 students.

4. *Professional and Special Schools.*

2 Polytechnic schools, one at Lisbon, with 175 pupils, and a second at Oporto, with 219 pupils.

1 Naval school, at Oporto. 1 School for naval cadets, at Lisbon.

1 School of commerce, at Lisbon, instituted in 1756.

1 Normal school, with a branch normal school at Santarem.

1 Military academy, at Lisbon. 1 Cadet academy.

1 Agricultural institute, with four model farms.

1 Academy of the fine arts, at Lisbon, with 377 pupils, and a school of drawing, at Oporto, with 127 pupils.

1 Academy of music. 1 Institute for the mechanical arts.

3 Schools of medicine and surgery.

1 School of veterinary surgery, at Bemporta.

1 Institution for deaf mutes. 1 Institution for the blind.

9 Clerical seminaries, with preparatory courses in Latin.

## PUBLIC INSTRUCTION IN PORTUGAL.

### *Government Institutions.*

THE PUBLIC SCHOOLS founded and supported by the Government of Portugal, and having special relations to Agriculture, Mining, Navigation, Trade, and Mechanics, &c., are the following:—

POLYTECHNIC SCHOOL IN LISBON; the course of studies, consisting of lectures by regular Professors, comprises mathematics in all its branches; natural history; natural philosophy in all its branches; chemistry, theoretical and practical; crystallography and mining, civil engineering, and agronomy. Students intending to go into the corps of civil or military engineers, must have a diploma from this School or that of Oporto before being admitted.

POLYTECHNIC SCHOOL AT OPORTO, similar in every respect to the School at Lisbon, and with power to grant the same diplomas.

MILITARY SCHOOL IN LISBON, specially intended for army cadets designing to enter the infantry or cavalry line regiments.

NAVAL SCHOOL IN LISBON, specially intended for navy cadets. It is established at the Lisbon dockyard. The course of studies, which is considered very thorough, comprises all the theoretical and practical exercises of the profession, with occasional short cruises of the more advanced classes in one of the ships of war.

Admission to the above schools is obtained only by successfully passing a stringent examination as to physical condition, and the studies of the secondary schools.

AGRICULTURAL INSTITUTE AT LISBON, embracing lectures on geometry, algebra, land surveying, agricultural chemistry, botany, veterinary science and its applications. There is likewise a practical course for farm laborers, dairy-men, and farming in general, together with farm book-keeping, and accounts. They have a good collection of veterinary specimens, infirmaries for sick cattle, museum of agriculture, and animal anatomy. Attached to, or under the supervision of the Institute, there are three or four model farms in the country, well organized and kept up, and the government are getting imported, chiefly from England, live stock for improving the breeds of horses, cows, sheep, pigs, &c., &c., and give the use of stallions to farmers who so desire it.

INDUSTRIAL INSTITUTE AT LISBON, designed for the mechanical arts, lectures on elementary geometry, drawing, chiefly of ornamental designs, and practical application of carpentry, joinery, turning in wood and metals, and practical instruction in the making of mathematical instruments of all sorts.

SCHOOL OF COMMERCE AT LISBON, comprising studies of Portuguese, English, French, and German languages, arithmetic, mathematics, and book-keeping.

ACADEMY OF FINE ARTS AT LISBON, dedicated to practical studies in drawing from the figure and design, historical and natural oil painting, modeling, and sculpture; and a school, for the higher classes, of drawing from the nude. The Academy contains a small collection of fine old paintings by good masters, chiefly collected from the convents of monks which were abolished in Portugal in 1834; but the Academy, being established in one of these abolished convents, and having very little means at its disposal, has not yet been able to organize its museum or gallery of pictures.



## SPECIAL INSTRUCTION IN SPAIN.

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### INTRODUCTION.

THE KINGDOM of Spain occupies the larger portion of the great Iberian Peninsula. Its length is about 560 miles, with an average breadth of 380 miles. The coast-line on the Atlantic is 605 miles, and on the Mediterranean 712—a total of 1,307 miles. The area, including the Canary and Balearic Isles (Majorca, Minorca), comprises 143,508 English square miles, with a population in 1864 of 16,287,675. To these must be added its colonies in America, Asia, Africa, Oceanica, with a population of about 5,000,000. The country has great variety of soil, well watered, and well adapted to the cultivation of the great agricultural slopes, as well as the heat-loving fruits—corn, and wine, and oil, cotton, wheat, flax, oats, coffee, sugar, cocoa, oranges,—every thing which domestic consumption and a foreign commerce could ask. Water power and water communication abound, affording every facility for manufacturing enterprise. All the elements of national prosperity seem to exist—except a stable and liberal government and a comprehensive system of national education—a system large enough to reach every family and touch every industrial interest.

### PUBLIC INSTRUCTION.

As late as in 1808, the control of education was with the clergy, and schools of the higher grades were numerous, and well cared for; but the mass of the population was hardly touched by this instruction. In 1797 only 322,126 children of all classes attended primary schools. In 1808 the Cortes introduced a system of State supervision, and in 1812, 1820, and 1825 attempted various measures, of which the most effective was a system of central and provincial Normal or model schools. Under even this imperfect State supervision [the Ministry of Education, Industry and Public Works] the number of public institutions and pupils has greatly increased, as appears by a recent official publication, of which the following is a summary:

*School Statistics—1865.*

I. ELEMENTARY SCHOOLS.—These are classified into Primary for very young children, and Superior for the older, with other schools having both older and younger pupils. Of those of a public character there were 18,250, of which 109 were for infants, and 272 for adults—having an aggregate attendance of 912,195 pupils. There were besides 3,800 private schools of an elementary character with 134,383 pupils, making an aggregate of 22,060 schools, and 1,251,653 pupils, or one to every 13 of the population. The census shows a large number of adults not reached by any school, public or private.

II. SECONDARY SCHOOLS.—These embrace the following institutions:—Fifty-eight public colleges, with 10,525 pupils; 42 private colleges with 3,241 pupils, and a large number of boarding institutions under the charge of ecclesiastics, with 22,000 pupils. There are also belonging to this class numerous colleges, which are supported by the municipalities, every large town and village being bound, in proportion to its population, to maintain one or more of these schools for public instruction.

III. SUPERIOR INSTRUCTION.—There are 10 Universities, each with a Faculty of Science, Philosophy and Law; 6, Theology; 7, Medicine, and 4, Pharmacy—as follows:—

*Ten of Sciences.*—Barcelona, Granada, Madrid, Oviedo, Salamanca, Santiago Seville, Valencia, Valladolid, Zaragossa—46 professors, 127 students. *Ten of Philosophy and Literature.*—51 professors, 191 students. *Ten of Law.*—80 professors, 3,742 students. *Six of Theology.*—Madrid, Oviedo, Salamanca, Santiago, Seville, Zaragossa—14 professors, 326 students. *Seven of Medicine.*—Barcelona, Granada, Madrid, Santiago, Seville, Valencia, Valladolid—73 professors, 1,155 students. *Four Pharmacy.*—Barcelona, Granada, Madrid, Santiago—11 professors, 563 students. *Total,* 275 professors, 6,104 students.

IV. SCHOOLS OF SPECIAL INSTRUCTION.—

Commerce, 9, with 27 professors and 553 scholars;  
 Navigation, 14, with 40 professors and 586 scholars;  
 Farm Superintendence and Hand-Surveying, 5, with 20 professors and 402 scholars;  
 Veterinary, 4, with 15 professors and 1,078 scholars;  
 Civil Engineers, 1, with 10 professors and 115 scholars;  
 Mines, 1, with 8 professors and 34 scholars;  
 Forestry, 1, with 4 professors and 12 scholars;  
 Architecture, 1, with 7 professors and 23 scholars;  
 Industrial Schools, 6, with 54 professors and 1,806 scholars;  
 Diplomacy, 1, with 6 professors and 43 scholars;  
 Notarial Schools, 10, with 471 scholars;  
 Painting, 7, with 20 professors and 2,271 scholars;  
 Sculpture, 3, with 7 professors and 114 scholars;  
 Engraving, 3, with 3 professors and 14 scholars;  
 Music and Declamation, 1, with 37 professors and 531 scholars.

According to the statement of an article by Prof. Le Roy in the *Encyclopedie Pedagogic*, on the school system of Spain, there were in 1860 8,611 students in the different universities; 24,353 Elementary schools, of which 20,198 were public.



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