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ABSTRACT

This newsletter is divided into six sections: Introduction and Call for Contributions, News Items and Coming events; Communications from Readers; Science-and-Society Courses and Programs; Selected Reading List on Science-and-Society Courses and Programs; and Bibliography #3. The bibliography is a list of books and articles intended to update the two preceding bibliographies. Entries are classified as relating to (1) assumptions, ethics, and goals and general world view of science, and to public attitudes toward it; (2) applications of recent advances in science and technology, and to government science policy; and (3) attempts to explain or defend science, technology, and the scientific endeavor, or modes of communicating science and technology to the public. (PEB)

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NEWSLETTER #3
of the
PROGRAM ON PUBLIC CONCEPTIONS OF SCIENCE

Contents

April 1973

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NEWSLETTER #3

of the

Program on Public Conceptions of Science

I. Introduction, and Call for Contributions

The current issue of the Newsletter differs in at least three respects from the two previous issues (October 1972 and January 1973). First, it consists largely of contributions from readers.* Second, a major portion of it focuses on one particular aspect of the public understanding of science--in this instance, on Science-and-Society courses and programs offered in schools and colleges in the United States. Third, the Bibliography is divided into two sections, one being a selected reading list on Science-and-Society courses and programs, the other being a continuation of the general Bibliographies of Newsletters #1 and #2.

The response to our request for contributions from Newsletter readers has been encouraging, as will be evident from Sections II through IV. It is hoped that readers will continue to submit notes of the sort which are reproduced here.

Newsletter #4 (July, 1973) is scheduled to focus upon Science and the Media; hence we now welcome contributions from our readers on their own experiences in communicating science to particular segments of the public through newspaper articles, popular science journals, public lectures, or television, or on their plans for doing so. Material for Newsletter #4 should be in our hands no later than May 31, 1973.

William A. Blanpied

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* Contributors include Michael Ambrosino, Nandor Balazs, George M. Basala, Otto T. Benfey, Bart J. Bok, L. Lawrence Bucciarelli, Anne H. Cahn, Earl Callen, Von Del Chamberlain, Leonard Eisenbud, Dave Hafemeister, Marie-Pierre Herzog, Frederick A. Long, Michael J. Moravcsik, George T. O'Hearn, Leo Perlis, Peter M. Sandman, Brian Schwartz, Henryk Skolimowski, Charles D. Spencer, Leon E. Trachtman, and Charles Weiner.

II. News Items and Coming Events

1) A symposium on "Science and the New Challenges to Rationality" was held at the Washington, D.C. AAAS Meeting on December 29. Thirty-minute papers were presented by:

Edward Shils (Department of Sociology, University of Chicago, and Peterhouse, Cambridge University)
"The Attack on Rationality and the Future of Science"

Charles Frankel (Department of Philosophy, Columbia University)
"The Nature and Sources of Irrationalism"

Bernard Gifford (President, The New York City Rand Institute)
"To What Extent Can Quantitative Methods Illuminate and Help Solve the Problems of Local Government?"

Masao Watanabe (Department of the History of Science, Tokyo University)
"The Conceptions of Nature in Japanese Culture"

Prepared commentators on the papers were Roger Hahn (Department of the History of Science, University of California, Berkeley), Brian Schwartz (Department of Physics, Massachusetts Institute of Technology), and William Blanpied (Department of Physics, Harvard University).

A news item entitled "Science Tilts with Irrationalism" in the January 1973 issue of Chemical and Engineering News reported on the session:

> "...Some roots of irrationalism come from science itself, sociology professor Edward Shils of the University of Chicago points out. From an original position of exploring God's will, science became secularized first to a largely esthetic pursuit of cognitive understanding of the universe and then to a pragmatic development of knowledge useful for man's comfort or defense. The latter effort has brought vast financial support but has given science an association with political power leading to distrust of a scientist's motivation.
>
> "In a long defense of rationality, read to the AAAS Meeting ... Professor Charles Frankel of Columbia University also pointed out weaknesses in the scientific field inviting distrust. 'One is the damage done by uncontrolled technological change; another is the discredit done to the common

sense and common humanity of scientists by individuals, some of them scientists, some of them charlatans, who present, in relation to complex and grievous human problems, simplistic notions that parody scientific notions.

" 'And considerable damage has also been done by scientists, among whom social scientists are perhaps the most notable, who exaggerate the amount of sound and applicable knowledge they have, and who offer confident solutions to social problems which, when tried, turn out to be only a mixture of pious hope and insular moral judgments,' he said.

"One practical consequence of irrationalism, Dr. Frankel cites, is that society must invest less or nothing at all 'in maintaining institutions and codes of ethics and etiquette which have been proved necessary to nourish the emotion of reason. Only an extraordinarily sanguine attitude about the inherent reasonableness of man's instinctual life--only a confident faith, belied by all experience, in the natural fit, the unforced, providential symmetry between the needs of human nature and the structure of an accommodating universe--can explain the willingness to take such a chance on spontaneity.'

"Finally, Dr. Frankel suggests, perhaps with a wink, that arguments between rational inquiry and irrationalism may be misunderstandings over what are simply matters of taste. After the verbal clashes, essential differences still remain as between Haydn and Wagner. 'And I cannot refrain from asking whether irrationalists absolutely must say the silly things they do about people whose esthetic preferences and personal styles are different from theirs.'" [The full paper by Dr. Frankel is scheduled for publication in Science.]

2) Excerpt from Inside AIP (Newsletter of the American Institute of Physics), February 6, 1973:

"At the recent AAAS sessions in Washington, a panel on the use of TV for Science Communication was arranged by Howard Lewis of the National Academy of Science, and chaired by Gene Kone, AIP's former Director of Public Relations....

"Allan Bromley [Chairman of the Yale University Physics Department] said that science is public knowledge; it has suffered too long from benign neglect; too much time has

been spent communicating within its own elite group; no longer can we afford a scientifically illiterate citizenry--when people don't understand, they tend to become disaffected. Dr. Bromley feels that scientists themselves have been at fault in their aloofness. He says that any scientist who can't explain to the public what he's doing, doesn't understand it himself. The adventure, beauty, and aesthetics of nature can be told and must be told. He feels that TV has replaced the Bible in that the viewer believes what he sees on TV as he used to believe what he read in the Bible. He cautions that scientists must express themselves clearly and succinctly because those who ramble on and on while being interviewed reinforce the images of absent-minded scientists."

3) The January 10, 1973 Presidential Address delivered by Bart J. Bok to the American Astronomical Society at Las Cruces, New Mexico, entitled "The State of Astronomy," reports on the Society's new program in education:

"The American Astronomical Society is engaged upon two major efforts in the field of astronomical education outside the area of professional education. Our Executive Officer, Mr. H.M. Gurin, has for many years been in charge of our Program of Visiting Professors in Astronomy, which is continuing in spite of withdrawal of support from NSF. To coordinate other activities in the educational field, we established at the East Lansing Meeting, a Task Group for Education in Astronomy, with Donat Wentzel and Gerrit Verschuur as co-chairmen. In addition, Kenneth Franklin of the Hayden Planetarium, and William Kaufmann of the Griffith Observatory, have agreed to act as Public Information Representatives of the Society, responsible for press, radio and TV relations at AAS meetings. Through these varied activities we are laying the foundation for strong public support of astronomy in our country."

Copies of the report are available from Professor Bart J. Bok, Steward Observatory, University of Arizona, Tucson, Arizona, 85721. [See also: Verschuur, Gerrit, and Wentzel, Donat G. "The TGEA--A New Educational Venture of the AAS." Bulletin of the American Astronomical Society vol. 4 (1972) p. 405.]

4) A symposium on "Science for Survival" was held at Dickinson College, Carlisle, Pennsylvania 17013, March 7, 8 and 9 in conjunction with the college's Joseph Priestley

celebration. Participants included Philip Abelson, who became the 22nd Joseph Priestley Award recipient, Cora DuBois, Arthur W. Galston, Gerald Holton, John G. Kemeny, and Charles C. Price. Proceedings of the sumposium will be published.

5) Michael Ambrosino of Public Television Station, WGBH, Boston, has announced the formation of a new Science Program Group whose purpose will be to produce high-quality films on science for the television-viewing audience. Details will be presented in the next issue of this Newsletter.

6) The first issue of a Science and Society Newsletter for California teachers of Science-and-Society courses, called Sci-Soc News, was issued in December 1972 as an outgrowth of an informal Cambria, California conference held over Memorial Day weekend. Sci-Soc News includes a list of Science-and-Society courses in California (reproduced in Section IV below), a list of audiovisual and textual resources for such courses, and a test on subjects in Science and Society for physicists that "attempts to measure how well the physics community has done its homework on the arms race."

Copies of Sci-Soc News are available for a $1.00 donation from Dave Hafemeister, Physics Department, California Polytechnic State University, San Luis Obispo, California 93401.

A second Cambria Conference is planned for May 26-28. According to the organizers it will be "decidedly informal: sessions next to a rustic fireplace or overlooking the ocean, with lots of time for informal chats. Be prepared to help cook a turkey and wash a dish or two. We would like to gather about 50 or 60 participants, mostly teachers and some students of Science-and-Society. The main thrust will be the interface between the natural sciences and society and government."

Contact Dave Hafemeister for further information.

7) The Forum on Physics and Society of the American Physical Society (APS) will present four two-hour-long symposia at the Washington, D.C. Meeting of the Society to be held at the Shoreham Hotel, April 23-26, 1973:

April 23, 9 a.m.	"Energy"
April 24, 9 a.m.	"Secrecy"
April 24, 8:30 p.m.	"Responsibility of the Scientist"
April 25, 9 a.m.	"Speculations on the Historical Development of Science"

Although membership in the Forum is restricted to APS members, its symposia are open to the public.

[Submitted by Brian Schwartz, Program Chairman, Forum on Physics and Society.]

8) Professor William A. Wallace, School of Philosophy, the Catholic University of America, Washington, D.C. 20017, reports that he will direct a National Science Foundation Summer Institute, primarily for college and university science teachers, from June 11-July 20, 1973. Its theme will be "The Nature, Relevance, and Scope of the Physical Sciences," and a number of distinguished visiting faculty will contribute to it. For further information, write to Professor Wallace.

[Courtesy of the "History of Science Society Newsletter."]

III. Communications from Readers

Several letters have been received from readers of the Newsletter which outline their thoughts and/or their activities in the Public Understanding of Science field. These are excerpted below. A few which deal specifically with Science-and-Society courses and programs are excerpted in Section IV. We are encouraged by the receipt of these letters and hope other readers will submit similar reports on their ideas and activities so that the "Communications" section can become a major feature of these Newsletters.

1) Excerpts from a letter from Dr. Marie-Pierre Herzog, Director, Division of Philosophy, UNESCO, Place de Fontenoy, 75 Parie 7e, France.

"The Division of Philosophy has just completed a programme on Science and the diversity of cultures, the results of which will be published in French this year and in English in 1974.

"As a follow-up, but with a different approach, UNESCO's Science Sector will initiate next year a 'Science in the 1970's' programme to further understanding of the complex relationships that exist between science, technology and society.

"Among the activities planned are a study of human implications of scientific advance (involving an analysis of the problem and an outline of a programme of studies which UNESCO could carry out in the future) and three meetings,

the largest of which will be organized in 1975 in cooperation with the Division of Philosophy and will consider the cultural, ethical and aesthetic issues involved. A second aspect of this programme will endeavor to improve the public understanding of science and its relationship to society."

2) George M. Basala, Department of History, University of Delaware (Newark, Delaware 19711) has submitted the following outline of his research activities:

"For the past four years I have been working on topics that might be of interest to you and the program. Dissatisfied with the traditional discussions of science and public understanding, I turned to a study of science in popular culture. Pop science is the presentation of science in comic strips, feature films, TV shows, and the like. Pop science is radically different from popular science; the latter, I find, is the establishment speaking to itself (i.e., Scientific American, the winners of the Kalinga and Arches of Science awards, etc.). If we want to know about the public reaction to science we will not find it in the pages of Scientific American, but we might learn something about it in a popular comic strip or science fiction film. I made a systematic study of comic strips (1945 to present), comic books, popular scientific novels, films, and TV shows. My research indicated that the scientist is depicted as a queer, untrustworthy individual who in one way or another contributes to social instability.

"From pop science I turned to technology. I made a study of the popular response to the most important machine in America--the automobile. The result is 'The Machine as a Sexual Object,' a lecture which I am now rewriting as a book. Then I chose America's legendary folk-hero, Paul Bunyan, and examined the American attitude towards nature as seen in Paul Bunyan stories. Finally, I have just completed an article (for a Winterthur [Delaware] Museum conference) on the presentation of technology and its history in museums of science and industry.

"Currently I am working on the image of the physician in popular culture under a grant from the DIMER (a Delaware medical research agency). And I am gathering materials for another study on the popular American reaction to the Hiroshima-Nagasaki bombs." [See also page 21 of this Newsletter.]

3) Anne H. Cahn of the Center for International Studies, M.I.T. (Cambridge, Massachusetts 02139) writes:

"Public conceptions of science, it seems to me, are shaped to a large extent by the interactions between the scientific and political communities. My own interests have thus tended to focus on the relationship between scientists and politicians, on all levels of government and in both the executive and legislative branches.

"Currently I am investigating the emerging contacts between scientists and the Congress. The recently-established congressional Office of Technology Assessment (OTA) is an institutional response by Congress to its perceived need for scientific and technical information and advice. A 'first look' at the potentialities and limitations of the OTA, co-authored with Joel Primack, will appear in the March 1973 issue of Technology Review.

"A lesser known effort to effectuate improved Congressional understanding of the technical implications of legislation was initiated by the scientific community. The Federation of American Scientists in 1970 organized in each congressional district a Technical Advisory Committee, consisting of about half a dozen scientists and engineers. Each Committee is to provide its Congressman with position papers and advise on issues of concern to areas of their expertise. An evaluation of this project is currently under way.

"A second major line of my current research is to take a comprehensive look at the phenomenon of science advertising. From a survey of the available literature we hope to sort out the recurrent themes, biases, observations. Can any of the propositions regarding technical advice and political decision-making be operationalized and thus become verifiable?

"Scientists and other technically trained people serve as advisors to political decision-makers in most nations of the world, but until now no attempt has been made to utilize a comparative perspective in examining the phenomena. Are the strategies that seem to maximize interpenetration between scientific and political factors and minimize friction between them in countries such as Israel and Japan of an idiosyncratic nature or are there lessons to be learned for the United States, Great Britain or the Soviet Union?

"Most of the studies that deal with the relationship between scientific advice and political decision-making view this interaction as existing only between decision makers in the executive branch and the members of the scientific community. However, increasingly legislatures around the world are beginning to assert their need for securing technical advice and expertise as well. Are the factors inhibiting effective communication between legislators and scientific advisors the same, similar to or different from those affecting communication between administrators and their technical experts? Is conflicting scientific advice dealt with in the legislative arena much as it is in the executive? Is technical advice utilized, suppressed or ignored more or less in the different branches of government? These are some of the questions to which I plan to address myself in the coming months."

4) Leo Perlis, Director, Department of Community Services, AFL-CIO (915 16th Street, N.W., Washington, D.C.), has sent a copy of an August 26, 1970 Memo he wrote, entitled "The Role of Science in Our Society." It discusses various reasons for and consequences of the lack of public understanding of science in the U.S., and proposes the creation of a national citizens' committee on science in society with a small permanent staff in a national headquarters in Washington, D.C. and in four regional offices throughout the country. The introduction to Mr. Perlis' memo emphasizes the need for two-way communication between scientists and the public:

"This memorandum addresses itself to two major problems confronting the nation generally and the scientific community particularly:

1) The relative lack of public understanding of the roles and values of science in modern society (complex, technological, urban, industrial, independent).
2) The relative lack of understanding by the scientific community of the role of science and scientists in a democratic society (open, egalitarian, skeptical, controversial, fluid)."

5) Peter M. Sandman, School of Natural Resources, University of Michigan (Ann Arbor, Michigan 48104) writes:

"Although I agree with you that we must rethink the value implications of professionalized (and institutionalized) scientific research, my own interest is in the

diffusion of scientific and quasi-scientific information through the mass media. The journalist has several roles in scientific diffusion, none of which is adequately fulfilled. Chief among these are: (1) Reaching the public with scientific findings in a manner that is palatable and comprehensible, yet essentially undistorted; (2) Interpreting for the public the policy implications of science, especially where scientists avoid doing so; (3) Creating in the public mind an accurate feeling about the process of science, its potentials and limitations; and (4) Influencing public attitudes and behavior with respect to the utilization and implementation of scientific findings and technological developments.

"I am currently directing a graduate program in Environmental Communication which attempts to train students to do (and study) these things in the arena of environmental sciences."

Excerpts from the syllabi of two of the courses Professor Sandman offers at the School of Natural Resources appear on pages 19 and 20.

A chapter by Professor Sandman entitled "Mass Media Education: Can the Media Do the Job?" in a book edited by William B. Stapp and James A. Swan will be published later this year by Sage Publishing Company.

6) Charles D. Spencer of the University of North Carolina's Physics Department (Chapel Hill, North Carolina 27514) has written his thoughts on the current public disenchantment with science:

"After working with several hundred students the past few years, after trying to keep up with what was being written, I have come to find it useful to divide the rebellion against science into two parts. One, of course, is the widely discussed counter-culture view of science which is roughly the same as the long-existing humanistic view.

"Equally important in terms of visible public sentiment and perhaps more important in terms of dollars appropriated for research is a change in what people believe science can do for them and for society. This change is not from support to opposition, but from a faith that science is the key to utopia to the view that utopia is not within reach. I would like to make a brief case for this second, less-widely discussed aspect of the rebellion....

"...Many people no longer agree with the words of I.I. Rabi when he wrote: 'Science inspires us with a feeling

of hopefulness and of infinite possibility. The road ahead may be invisible, but the tradition of science has shown that the human spirit applied in the tradition of science will find a way toward the objective. Science shows it is possible to foresee and to plan and that we can take the future into our own hands if we rid ourselves of prejudice and superstition' (from a 1953 essay in Atlantic Monthly).

"It seems to me that there are two levels upon which concern has been expressed over the consequences of the public's change in attitude. One, primarily in response to the counterculture, is the fear that a wave of unreason is sweeping the land, a wave that will lead to irrational behavior, irrational beliefs, and irrational decisions. One of many expressions of this fear is found in Eugene Rabinowitch's essay 'The Mounting Tide of Unreason,' published in the May 1971 Bulletin of the Atomic Scientists. The other level of concern is over what will happen to the vitality of science during a time when there is less prestige and no money for growth (growth is really the only way to bring in new people). My feeling is that while public education programs are long overdue, they will not address this real problem. If the scientific community believes science is vital to man's future and if renewed support based on more realistic purposes cannot be readily attained (which is probably the case), then the burden of keeping science going is in the hands of scientists themselves. They will have to work harder and demand more of each other.

"The purpose of all this is to argue that what we see as a rebellion against science has an aspect distinct from the counter-culture. Further, the purpose is to suggest a systematic study of what science promised society. This could be done by reviewing relevant congressional and legislative testimony, by reviewing newspaper editorials and mass media programs, by reviewing the school children's 'Weekly Reader,' etc. It would be worthwhile to know if science promised too much and as a consequence may have hurt its ability to play a vital (but not epic) role in society."

7) Leon E. Trachtman, Associate Dean, School of Humanities, Social Science and Education, Purdue University (Lafayette, Indiana 47907) writes:

"I have been personally concerned for well over a decade with a number of the problems you discuss. As a science writer, first for the National Institutes of

Health and then the Purdue Research Foundation, I was distressed (and still am) about the character and quality of much of the information about science prepared for public consumption. It may be that part of the more recent disenchantment about science which is rooted in the counterculture may have a deeper historical basis in the shallow and mindless way science was presented to the general public during the expansive days of the late forties, the fifties and the early sixties.

"Because of my interests, I originated and have been teaching since 1966 a graduate-undergraduate course in Science Writing at Purdue University. This course has now been absorbed by our new Curriculum in Science and Culture, one of the goals of which is to understand the contemporary disenchantment syndrome which you describe. I am enclosing for your information an announcement and brief description of this curriculum. We currently have about a dozen undergraduate majors in Science and Culture."

Further information on the Purdue Curriculum in Science and Culture, and reprints of a June 1962 article by Dean Trachtman entitled "Writing About Writing" which was published by the Purdue Research Foundation, can be obtained from his office.

8) Excerpts from a report by Charles Weiner, Director of the American Institute of Physics Center for History of Physics, to the Governing Board of the AIP follow:

"In 1972 the Center's Niels Bohr Library celebrated its 10th anniversary. The emphasis of the Center's programs during the year was on making the resources which had been developed during the initial decade more widely known and more useful for educational and public understanding purposes. This was reflected during the year in publications, lectures, and exhibits directed to far more diversified audiences. The purposes of the Center's program are now four-fold: to insure that the original source materials documenting the growth and impact of physics in our time are preserved; to conduct, encourage and help make possible scholarly studies that will contribute to understanding of the development of 20th-century physics and its relation to society; to stimulate an appreciation of the history of physics within the physics community; and to foster wider public interest in the historical development of recent physics and its role in society.

"During the year, exhibits and talks by staff made use of Center resources to increase understanding of the development of physics. A major exhibit, 'Physics in 1922,' was prepared for the 50th Anniversary Meeting of the Interntional Union of Pure and Applied Physics. The exhibit was displayed at three additional institutions in 1972 and will tour at twelve

institutions throughout the U.S. during 1973. Charles Weiner was an invited speaker at physics colloquia at six universities and also gave invited lectures at a meeting of The American Physical Society and at the American Association for the Advancement of Science.

"During the year groundwork was laid for a 1973 preservation and research effort focusing on postwar physics and astronomy. A systematic survey will be conducted to locate collections of source materials and to provide assistance in arranging for their preservation at appropriate repositories throughout the country. Project plans include the publication of a report on the survey to encourage scholarly studies. Plans were also made for a serious examination of the Center's collections in 1973 to select audio, visual, and documentary resources which might suitably be developed for use in imaginative formats in a variety of media, in order to make them available to the scientific community and to wider public audiences."

[For further information contact Dr. Charles Weiner, Director, American Institute of Physics, Center for History of Physics, 335 E. 45, New York, New York 10017.]

IV. Science-and-Society Courses and Programs

Virtually all of the items in this section have been submitted by our readers in response to a request made in Issue #2 of the Newsletter (January 1973). Any additional course and program notes which are received will be reproduced in subsequent issues.

1) A course given at the State University of New York at Stony Brook by Nandor Balazs and Leonard Eisenbud was featured as an "Anti-Science" course on December 18, 1971 in a New York Times article. In a recent letter Professor Eisenbud wrote:

"Essentially our course and your program are concerned with the same issues--the causes and possible cures of the diseases of anti-rationality and anti-science. Incidentally, our course has about 150 students--mostly high school and grade school teachers from Suffolk County--who are in a so-called 'master of liberal arts' program."

Excerpts from the description of the course handed to the students follow.

"This course will attempt to describe and analyze the recent growth of anti-scientific attitudes (antiscience is defined as the view that science, for one reason or another, is more productive of evil than of good). The relations between antiscience and anti-rationality will be examined, and the relative merits of various popular antiscientific positions will be evaluated.

"Among the questions to be discussed are the following:

Is antiscience restricted to opposition to the consequences of science and technology or is it part of a broader attack on rationality?

Does antiscience have a history? If so, does the history help us to understand current developments?

Who are the major protagonists of antiscience? What are their positions and what arguments support them?

Is antiscience simply a response to such threats as atomic warfare, the population explosion, environmental deterioration, or are its roots embedded more deeply in the nature of man and civilization?

If science cannot save all of us, what will? What substitutes or alternatives does antiscience propose?

"The lectures in the early weeks of the course will introduce major themes and representative writings. A range of conflicting opinions concerning the role and value (or disvalue) of science will be presented by members of the University faculty (from a broad range of disciplines) in panel discussions and debates. The ideas generated in these discussions and lectures together with those obtained from readings will be used to prepare for the debates between the course participants which are to be held at the end of the semester. The concluding session will be a team debate in the style of those traditionally held by the Oxford Union. A possible resolution for the final general debate might be: 'Antiscience does more than science can to make life livable for man.'

"Suggested topics for 'debate briefs:'

Human nature is essentially good if uncontrolled; human nature requires constant control.

The only good knowledge is scientific knowledge; essential knowledge is non-scientific.

Myths can provide more (less) ultimate satisfaction than the truths of science.

Science & technology promote the equality of man.
Science & technology generate class differences.

Science & technology promote freedom (curtail freedom).

Control of technology is possible (impossible).

Soft technology can be (cannot be) controlled.

Hard technology can be (cannot be) controlled."

2) Otto T. Benfey, Editor of Chemistry and Professor of Chemistry, Earlham College (Richmond, Indiana 47374) has submitted an outline of a one-quarter, junior-senior level course in history of science which he offers to scientists. Although the course is devoted largely to intellectual history, Benfey also introduces material on science and society. Dürrenmatt's play, The Physicists, was presented during the Winter 1972-73 quarter; occasional lectures on "Social Responsibility of Scientists--Historical Perspectives" are given; and in the preparation of a required scientific biography each student is instructed to report on the subject's "religious or philosophical outlook and the origin of these views" and "the person's interests and activities outside of science. Did he (she) feel conflicts between scientific activities and ethical or social or ecological ideals?"

3) L. Lawrence Bucciarelli, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology (Cambridge, Massachusetts 02139) has submitted a letter sent to M.I.T. Freshmen describing the 1973 Spring Semester plans for "Concourse," a special program of integrated studies for M.I.T. Freshmen. The following excerpts give some impression of the nature of the program.

"Concourse offers several complementary learning styles.

"a. General Meetings. The meetings themselves consist of lectures, discussions, seminars, debates, dramatizations, in a varying format--whatever seems appropriate to the subject matter for a given day.

"In these regularly scheduled sessions, which involve all Concourse students and a sizeable group of faculty, we explore intensively a number of selected interdisciplinary topics that have both broad educational value and specific relevance to the scientific and technical fields which most students will enter during their M.I.T. education. For the Fall semester our general theme was 'Sources and Contexts of Modern Scientific Thought,' a

study designed to illuminate the historical, social, and cultural dimensions of Science as an intellectual and practical activity."

.....

"The theme for the general meetings in the spring semester will be "Theories and Knowledge." The syllabus will be divided into three parts: the wave-particle duality, details of population growth, and a broadly based study of Sophocles' Oedipus Rex."

"b. Concourse Forum. The Forum is a weekly event; a formal presentation by a guest speaker or member of Concourse. The Forum is open to the M.I.T. public. Some of the topics for the fall semester were: the decision process that led to the dropping of the first atomic bomb, its control, the ABM debate, and the recent SALT talks. This semester we will concentrate on Modern Biology, Genetic Engineering, Laser Technology, and Philosophy of Science. The presentations will be followed by informal discussions and, on some occasions, dinner."

"c. Techniques of Disciplines. Techniques meets once a week for three hours and occasionally for an all-day session. Participation in these concentrated study sessions establishes a solid foundation in the basic skills in mathematics, physics, chemistry and writing necessary for meaningful engagement in the General Meetings as well as for more advanced work in upperclass departmental majors."

4) Cornell University has a well-established Program on Science, Technology and Society. A pamphlet giving details of the courses offered by the Program, and another with cumulative lists of its publications, are available from The Program on Science, Technology and Society at Cornell, 632 Clark Hall, Cornell University (Ithaca, New York 14850).

5) Science and Society courses in California (from "Sci-Soc News," December 1972) by Dave Hafemeister. See page 5 of this Newsletter.

a) Prof. David Frank, Department of Chemistry, Fresno State University, 93726, "Chemistry of Pollution."

b) Prof. Fred Cranston, Physics Department, Humboldt State, Arcata, 95521. HSU requires that all non-science students take a 2-unit course in Sci-Soc which counts towards their general education requirements.

c) Prof. George Johnston, Physics Department, Sonoma State, Rohnert Park, 94928, "The Relation of Physics to Society," which is taken by both science students and non-science students.

d) Prof. David Hafemeister, Physics, California Polytechnic State University, San Luis Obispo, 93401; Prof. Ron Ritschard, Biology, California Polytechnic State University; Prof. Norm Eatough, Chemistry, California Polytechnic State University. Three versions of Sci-Soc in progress, all 3-man interdisciplinary (Physics, Biology, Chemistry). In addition all engineering majors are required to take Humanities 401 which is a mix of engineering-humanities-political science. Dave Hafemeister would be glad to send his ABM chapter to whoever wants it.

e) Prof. H. Ibser, Physics Department, Sacramento State College, 95819. "Living with Nuclear Energy."

f) Professor Martin Perl, SLAC, Stanford, 94305, has been involved with SWOPSI (Stanford Workshops on Political and Social Issues) courses.

g) Prof. S.J. Klein, Mechanical Engineering, Stanford, has been involved with VTS (Values, Technology, and Society).

h) Prof. Charles Shapiro, Physics Department, San Francisco State, 94132, has been doing a senior-graduate level course for science majors.

i) Prof. M. Granger Morgan, Department of Applied Physics, UC, San Diego, 92037, has been teaching a course in Technology and Modern Social Problems for senior science students. (Amer. J. of Phys. 40 (1972): 116.)

j) Prof. Wesley Marx, of UC, Irvine, 92664, has done several environmental extension courses in the Irvine area. Author of The Frail Ocean.

k) Prof. Mashuri Warren, Physics Department, Hayward State University, 94542, has done a course entitled 'Energy, Power, and Politics.'

l) Prof. William Chinowsky, Physics Department, UC, Berkeley, 94720, has done a course on the Arms Race and Physics.

m) Prof. Larry Badash, History Department, UC, Santa Barbara, 93107, has looked at the historical facets of the atomic age.

n) Prof. Allan Krase, Physics Department, UC, Santa Barbara, 93107, has prepared a University of California extension course, Physics X102 entitled Science, Technology, and Man, which concentrates on the Arms Race. ($5, UC, Berkeley, Extension) Now at Princeton University.

o) Prof. Al Evans, Physics Department, UC, Irvine 92664, has prepared a course on Physics of the Environment which concentrates on energy aspects. Also he has developed computer simulations on these topics for the students. Now at General Motors Research Labs, Warren, Michigan 48090.

6) Michael J. Moravcsik, Institute for Theoretical Science, University of Oregon (Eugene, Oregon 97403), offers a one-quarter course in the department called 'Science Development.' The list of topics from his syllabus follows:

"a) Introduction: The Science of Science. b) Why science in less developed countries. c) Indigenous science education. d) Education abroad. e) Cultural aspects. f) Example: Thailand. g) Example: Nigeria. h) Some international aspects. i) Communication j) Science and technology k) Science policy l) International science. m) Scientific assistance. n) Brain Drain. o) Motivation and morale. p) Summary."

7) George T. O'Hearn, Executive Assistant to the Dean, University of Wisconsin (Green Bay, Wisconsin 54302), has suggested that the educational focus at the campus, first opened in 1969, might be of interest to Newsletter readers. The current (1972-73) catalog outlines this focus.

"The University of Wisconsin-Green Bay (UWGB) is one of the few universities in the world with a focus for all of its activities. That focus is man in his environment. Whether in teaching, research, or community outreach, the aim is to help student, instructor, and community member relate more effectively to, and do something constructive about, the environment.

"All of the courses necessary for basic preparation for a wide variety of professional, business, administrative and technical careers are available at UWGB. What makes UWGB different and distinctive is the fact that its courses are presented in the context of a unique academic plan. This plan relates study in all fields to problems of man's various environments. Thus the UWGB graduate, whatever his chosen vocation, is unusually well prepared to deal with

the greatest challenge facing his world. ....

"Chancellor Weidner has commented on the blending of the traditional and innovative at UWGB in these words:

"'There are basic intellectual skills that must be mastered by every person who is going to be a responsible citizen of any modern society. Beyond these basic skills, there are specialized skills that must be mastered by many of our citizens. The question of critical social importance, and the one to which the UWGB academic plan particularly addresses itself, is how each individual chooses to use the skills he acquires.'"

In an essay in Harpers Magazine (February 1971), John Fischer dubbed the University "Survival U." and wrote:

"...In its broad sense ecology embraces all other subjects. The places where a man works and sleeps are part of his environment, just as the air he breathes and the sounds he hears, including both motors and Mozart. Whether this environment is good or bad depends on many things--economics, engineering, government, and geography, to begin with. Even international relations, since war could be the ultimate destroyer of the environment. Understood in this way, as it is at Green Bay, ecology is not simply one academic subject among others. It becomes an approach to all learning, a framework for organizing every field of study."

8) Buel C. Robinson, Chairman of the Science Department of the Washington High School (Denver, Colorado 80222), reported on the school's Science-Humanities seminars in the October 1972 issue of The Science Teacher (p. 41). He writes of the students:

"They had acquired a deep distrust of technology, while at the same time they enjoyed its benefits and completely ignored those in power who control our machines. They lacked an understanding of our complex world. It was evident that we science teachers needed a way to reach our students with a carefully balanced appraisal of the role of science today. We needed to:

"Change the attitude of many students that science was the villain, causing many of our problems (pollution, population, and poverty, for example).

"Bridge the wide gap between the sciences and the humanities in order to be able to approach our human problems in a unified and effective manner.

"Prove that scientists are fully as involved in and concerned with the problems of our people as are any other group of citizens.

"Show that we are ready to apply scientific methods and techniques to the solution of these human problems.

"In particular we needed to demonstrate that in a country and school as ethically diverse as ours (we had just had several outbreaks of racial strife in the building), there are many equally valid and worthwhile ways of looking at the same idea. Finally, we needed something to bring a spark of interest and spirit to a building of three thousand students that had been forced by problems of racial tension to operate under near prison-like controls."

He then goes on to give a detailed description of the seminars and their reception.

9) Excerpts from the syllabi of two courses given by Peter M. Sandman, School of Natural Resources, University of Michigan (Ann Arbor, Michigan 48104) [see also pages 9 and 10].

Mass Media and the Environment

"Most Americans learn about the environment and environmental problems chiefly through the mass media. The purpose of this course is to look at what the media tell us about the environment, why, and with what effects. As a result of our investigation, we may come up with some proposals on how to improve media coverage of the environment. Or we may give up on the media entirely and begin looking for alternative means of mass environmental education.

"Very little has been written about the mass media and the environment; we'll read what's there, and talk about it. In addition, we will read about the structure of mass communication industries, the 'ideology' of journalism, the impact of information on attitudes and behavior, and the environmental values of the general public."

Writing About Environment

"This course is devoted to the skills of writing about the environment for nonscientific audiences. We will spend some time analyzing good and bad pieces of environmental writing, and reviewing research on the impact of

environmental writing. But most of the time we will write and rewrite--press releases, advertisements, textbook sections, speeches, pamphlets, magazine articles, etc.

"Some students in this course have extensive training in journalism and none in environmental science; some have extensive training in environmental science and none in journalism. The goal of the course is to help both scientists and journalists develop their skills in explaining the process, findings, and social significance of the natural resources sciences to a nonscientific audience in a manner that is palatable, persuasive, comprehensible, and accurate. Any student who writes sentences like the foregoing desperately needs the course."

10) Henryk Skolimowski, Department of Humanities, College of Engineering, University of Michigan (Ann Arbor, Michigan 48104), has contributed a paragraph on the aims of the New Science Group established in March 1971:

"The purpose of the new science group is the study, generation and application of knowledge relevant to the survival of society and the fulfillment of the individual. Concerted study of the interactions of science and technology with society have been neglected; such study is necessary before solutions to urgent problems could be reached and the remaking of society is made possible."

He has also provided brief descriptions of two courses he offers in the program:

Science and Civilization

"This course examines science in the context of Western Civilization and attempts to assess its influence on the making of the modern mind. It thus examines science as a cultural and cognitive phenomenon influencing both society and our scientific world view. It tries to answer such questions as: Why has science developed the way it did? Was this development inevitable or accidental? Will we have to develop a new kind of science in the future?

Philosophy of Technology

"Is technology a mere tool, an ideology, a form of the world view? Does it control us, or is it controlled by us? Are we responsible for its misuses, or is IT responsible for our predicaments? What New Technology must we develop in order to make technology compatible with a humane society? These and other questions are discussed and relentlessly pursued to the limit of the class' imagination. Technology is thus analyzed within the framework

of the entire Western civilization: a) as a social force, b) as a cognitive phenomenon, and c) as an assembly of techniques. The new technology as proposed by such men as Barry Commoner, Buckminster Fuller, Paolo Soleri is examined and evaluated. The social significance of present and future technology is in the focus."

11) Professor Harold I. Sharlin, Department of History, Iowa State University (Ames, Iowa 50010), reports that he and Professor Robert A. Leacock (Physics) this year began teaching a full-year course called "Physics, History and Society." The course is for freshmen primarily, and its purpose is to examine some of the basic ideas and theories in physics and history, and to find where these ideas agree or conflict in their view of man and society. The student is asked to decide whether the scientific world view and the humanistic ideal are compatible, and how to deal with possible irresolvable conflicts in today's society. The course can be taken for either history or physics credit, and the students do a minimum of three research papers per quarter. Plans are being made to make this course the foundation of a new cross-disciplinary program at Iowa State University. For further information write to Professor Sharlin. [Courtesy of the "History of Science Society Newsletter."]

12) George M. Basala, Department of History, University of Delaware (Newark, Delaware, 19711), writes:

"All of my teaching centers on Science-and-Society type courses, including:

a) Social Implications of Science and Technology (a two-term undergraduate lecture course--150 students)

b) Futures and Utopian Studies (an undergraduate lecture course critical of futurology--200 students)

c) Science Fiction as Social Criticism (use science fiction as a guide to issues in social history--250 students).

"In addition I have offered seminars on the automobile in American society, and the structures and thought of R. Buckminster Fuller."

Descriptions of Professor Basala's courses will be reproduced in the next issue of the Newsletter.

13) Earl Callen, Physics Department, American University (Washington, D.C. 20016), describes a number of courses at the University in a mimeographed memorandum (available from him) entitled "Sound, Light, Bombs, Sex and Public Policy--or American University on $5 a Day." The courses described bear the titles "Sound, Light, and the Arts;" "Arms Control and Science;" "Astronomy;" "Population, Resources, and the Environment;" and "Science, Human Values and Public Policy." Course syllabi and reading lists are included in the memorandum.

14) Von Del Chamberlain, Director of the Abrams Planetarium, Michigan State University (East Lansing, Michigan 48823), has written to describe his program of Sky Interpretation at National Parks and other Scenic Areas.

> "Perhaps one of the best ways to interest and inform people about the discoveries of astronomy and related sciences is to find opportunities to talk with people while standing together under the star-studded sky. This concept is the foundation of a training program for the National Park system and other outdoor agencies. Each year many millions of people leave metropolitan homes to travel through our natural scenic areas in order to enjoy and learn about the environment. The quality of the sky is one of the features of any natural region which makes it so enjoyable. Visits to natural areas are made more enjoyable by the work of naturalists who are skilled in ability to interpret the environment. This project attempts to help prepare naturalists to interpret the sky and its relationship with the more immediate environment. Slide programs at outdoor amphitheaters, night walks, observing with small telescopes and other procedures are being employed to help people understand and enjoy objects of the sky. Sky interpretation conferences are planned for each National Park region. In addition, a list of astronomers and planetarium instructors who are interested in volunteer activities at selected park units is being formulated. The National Park system is concurrently developing a list of park units interested in receiving such visits. It is expected that these activities will lead to additional opportunities to inform people about the work of astronomers, meteorologists and other scientists."

V. Selected Reading List on Courses and Programs on Science and Society

The list which follows consists primarily of items in published professional science education journals from January 1970 through February 1973. Like the more general bibliographies in this and the previous two Newsletters, it does not claim to be exhaustive. Most of the articles listed deal with courses or programs on Science and Society at the high school or college level. Most of these items would normally be included under Category III of the General Bibliography--"Explanations and Justifications of Science; Modes of Communicating Science." Courses on science for non-scientists have usually not been listed unless they do make some attempt to deal with broad social issues. Likewise, descriptions of environmental education at the school level have largely been omitted--in part because no matter how worthwhile they may be, many of these courses have been incorporated into school biology programs, and in part because there are now so many of these courses that more than a casual perusal of the journals would be necessary to provide an undistorted view of their scope.

A. Bibliographies and Reference Aids

A number of bibliographies and reference aids on science education are available. Among them:

1) From the
   Commission on Science Education of the
   American Association for the Advancement of Science
   1515 Massachusetts Avenue, N.W.
   Washington, D.C. 20050

   a) Science and Society: A Bibliography (3rd Edition, 1972). Cost: $1.00.

   b) Science Education News. Monthly newsletter available on request.

   c) Science-for-Society Education Review. Monthly newsletter available on request.

2) From the
   Executive Officer
   American Association of Physics Teachers
   Drawer AW
   Stony Brook, New York 11790

Resource Letters, or descriptive topical bibliographies for teachers, are published from time to time in the American Journal of Physics. They are also available in reprint form at 50¢ per copy from the Executive Officer. Three of particular interest are:

a) "Resource Letter SL-1 on Science and Literature," compiled by Marjorie Nicholson. Amer. Jour. of Physics, vol. 33 (1965), pp. 1-8.

b) "Resource Letter TLA-1 on Technology, Literature and Art since World War II," compiled by William H. Davenport. Amer. Jour. of Physics, vol. 38 (1970), pp. 407-14.

c) "Resource Letter ERPEE-1 on Energy: Resources, Production, and Environmental Effects," compiled by R.H. Romer. Amer. Jour. of Physics, vol. 40 (1972), pp. 805-29.

3) Since November 1966 the U.S. Office of Education (400 Maryland Avenue, N.W., Washington, D.C. 20202) has published Research in Education, monthly abstracts of articles and reports on education, including internal Office of Education reports.

The ERIC (Educational Resources Information Center) Educational Documents Index for 1970-71 incorporates references to all Research in Education entries as well as selected references on education from 1956-65. Many of the entries cited in this volume are available on microfiche.

B. Textbooks for Courses on Science and Society

While many textbooks for courses on science for the non-scientist have been written during the past decade, few textbooks intended explicitly for Science-and-Society courses have been published.

1) Dietrich Schroeer's Physics and Its Fifth Dimension: Society (Reading, Mass.: Addison-Wesley, 1972). The outgrowth of a one-semester course taught by the author in the Physics Department at the University of North Carolina. [See the review by William J. Mullin, Physics Today vol. 25, #12 (December 1972), pp. 49-50.]

2) Michael W. Friedlander's The Conduct of Science (Prentice Hall, Inc., 1972). While not strictly a textbook, could serve as the basis for a college-level Science-and-Society course. According to the

review by C.G. Wood in The Science Teacher (February 1973, p. 64), "the purpose of this book is to examine the new role of the scientist in modern society, particularly in the realm of social concern and responsibility. Topics covered include dissemination of information, controversy in science, research and the scientist's nonscientific role in society. ...The book is quite well done but on too high a plane for most secondary students."

3) The Project Physics Course is a 1-year course in physics and related sciences for college and high school students, published by Holt, Rinehart and Winston, Inc. (383 Madison Avenue, New York, New York 10017). The published materials include six Readers, anthologies of articles from the general literature which relate to the more formal course material. A pamphlet About the Project Physics Course is available free of charge from the publisher. The course stresses science-society links.

4) James E. Trosko, Associate Professor of Human Development at Michigan State University (East Lansing, Michigan 48823) and Dr. Van R. Potter, of the McArdle Cancer Laboratory, University of Wisconsin (Madison, Wisconsin 53715), are collaborating on a book for nonscientists entitled Biology for Humanists: a Foundation for Bioethics.

5) Frank von Hippel and Joel Primack are working on a book on Public Interest Science which will be published later this year. It includes several case studies in which scientists acting as citizens used their expertise to question and in some cases to modify technical decisions made by the Executive Branch of the Federal Government. It also discusses ways in which scientists can make themselves more effective advocates of the public interest. (See page 34, Newsletter #2.)

Information on other science-and-society textbooks, either planned or published, would be appreciated for use in subsequent Newsletters.

C. Selected List of Other Published Items

Achuthan, M. Radh. "On the Necessity of 'Long-Range Goals for Mankind--Interdisciplinary Undergraduate Major.' " Amer. Jour. of Phys. vol. 39 (1971): p. 709.

Abstract of a paper presented at the February 1971 New York City meeting of the American Association of Physics Teachers.

Andrew, Michael D. "Issue-Centered Science." The Science Teacher vol. 37, #2 (February 1970): p. 29.

Arnsdorf, Val. "Relationships of Social Sciences and Natural Sciences in Ecological Education." Amer. Biology Teacher vol. 34 (1972): p. 206.

Bailey, John M. "Physics and Everything: A Bibliography." Amer. Jour. of Physics vol. 39 (1971): p. 1347.

"A bibliography is presented that lists references connecting physics or technology with other academic disciplines. It has been used with great success by students writing research papers as part of a general physics course for non-science majors."

Baker, Adolph. "Physics and Antiphysics." Physics Today vol. 23, #3 (March 1970): p. 34.

"How do we show those students who believe physics to be a force for evil that physicists care about the real world's problems?"

Calame, Gerald P. "The Science in Science Fiction: A Seminar Course." Amer. Jour. of Physics vol. 41 (1973): p. 184.

"A seminar course based on the science used in selected science-fiction stories is described. The format of the course consists of reading stories and then discussing the physics (e.g., antimatter, relativity) which serves as the scientific background for the story. A partial list of books read, together with the background theme and appropriate references, is given. The student reaction to the course is enthusiastic."

Calandra, Alexander. "Science for Nonscience Majors." Jour. College Science Teaching vol. 1, #4 (April 1972): p. 35.

A description of a program consisting of short, "relevant" courses for non-scientists introduced at Webster College, St. Louis, Mo., in 1970.

Caldwell, Lynton K. "Megacrisis and the Need for a Science of Man." Amer. Biol. Teacher vol. 34 (1972): p. 443.

Cassidy, Harold G. "Physical Science for the Nonscientist and the Antiscientist." Jour. Chem. Ed. vol. 48 (1971): p. 212.

Cook, William B.; Hackerman, Norman; Slichter, W.P.; West, Robert; and Snyder, Milton K. "Chemistry and Social Concern." Jour. Chem. Ed. vol. 48 (1971): p. 642.

Five papers from an October 1970 AAAS Symposium on "Chemistry and Social Concern."

Cook, William B.; Chisman, D.G.; Nyholm, R.S.; and Rao, C.N.R. "Chemistry for the Concerned Citizen." Jour. Chem. Ed. vol. 49, p. 315.

Four papers from a Symposium on the topic held in Washington, D.C. in July 1971.

Cothern, C.R. "Teaching Science to Nonscience Majors--Some Attitudes, Ideas and Approaches." Amer. Jour. of Physics vol. 41 (1973): p. 41.

"The problems and some possible approaches in developing a course for the nonscience major are reviewed. The plan of this course involves combining "straight" physics with discussions of problems in the science and society area based on journal, magazine, and newspaper articles and some books. The major goal of this course is to change the attitudes of the students from fear and hostility towards science to an understanding and appreciation of how science contributes to their world and how they can contribute to a better relationship between science and society."

Creager, Joan G. "A Student Directed Course on Biological Problems in Contemporary Society." CUEBS News vol. 7, #5 (June 1971): p. 3.

Cowan, David J. "Environmental Topics in an Undergraduate Physics Curriculum." Amer. Jour. of Physics vol. 40 (1972): p. 1748.

"The number of bachelor's degrees in physics conferred annually is predicted to decline. This decline may be abated by emphasizing the versatility of an undergraduate physics degree. The introduction of environmental topics throughout the undergraduate curriculum is one method of

illustrating this flexibility, and this approach is presented. Examples of the applications of physical principles to several areas of environmental change are given. These areas are air pollution, energy conversion and resources, environmental radiation, noise, thermal pollution. Representative bibliographies are presented in each area to facilitate the introduction of these topics into the curriculum. For the most part, items in the bibliography refer to environmental problems that are amenable to the laws of physics."

Dash, J.G. "Teaching Physics, History, and Society: Experiences and Misgivings." Amer. Jour. of Physics vol. 39 (1971): p. 707.

Abstract of a paper presented at the February 1971 New York City meeting of the American Association of Physics Teachers.

D'Auria, J.; Gilchrist, A.; and Johnstone, J. "The Introduction of Relevance into a Chemistry Laboratory Course for Non-Scientists." Jour. Chem. Ed. vol. 47 (1970): p. 508.

Davenport, William H. "Resource Letter TLA-1 on Technology, Literature, and Art since World War II." Amer. Jour. of Physics vol. 38 (1970): p. 407.

A descriptive bibliography.

Day, Jean W. "Environmental Chemistry in the Classroom." Jour. Chem. Ed. vol. 47 (1970): p. 260.

Notes on a special lecture series on means of introducing the topic held at the Rutgers University School of Agriculture and Environmental Science.

Ehlers, Vernon J. "The Year 2000--A 'Relevant' Course." Amer. Jour. of Physics vol. 39 (1971): p. 697.

Abstract of a paper presented at the February, 1971 New York City meeting of the American Association of Physics Teachers.

Fuller, Edward C. "Chemistry and the Human Environment: A College Course for the Nonscience Major." Jour. Chem. Ed. vol. 49 (1971): p. 10.

Grass, Bernard F. "Scientific Literacy and the Nonscience Major." Jour. of College Science Teaching vol. 2, #3 (February 1973): p. 10.

"A genetics course for nonscience majors was redesigned with the aim of increasing students' scientific literacy."

Hafner, Everett M. "The Challenge of Environmental Education." Science Education vol. 56 (1972): p. 1.

Hart, Francis X. "Science and Society in the Classroom." Amer. Jour. of Physics vol. 38 (1970): p. 664.

A letter to the Editor outlining the author's personal experiences.

Hawkins, Mary E., et al. "Man and His Environment." The Science Teacher vol. 37, #6 (September 1970): p. 18.

A special issue on environmental education.

Hodges, Laurent. "A Course on the Physics and Chemistry of Pollution." Amer. Jour. of Physics vol. 39 (1971) p. 935.

"A course on environmental pollution which stresses physical and chemical principles is described. It presents a unified discussion of air and water pollution and solid wastes with special treatment of pesticides, thermal pollution, radioactivity, and electric power generation. Historical and current statistics have been used extensively to set pollution problems in perspective."

Holton, Gerald. "Improving College Science Teaching: Lessons from Contemporary Science and the History of Science." Jour. College Sci. Teaching vol. 1, #1 (October 1971): p. 31.

Holton, Gerald. "The Relevance of Physics." Physics Today vol. 23, #11 (November 1970: p. 40.

"As part of the fabric of life, physics should not be taught in isolation."

Hurd, Paul D. "Biology as a Study of Man and Society." Amer. Biol. Teacher vol. 33 (1971): p. 397.

Inglis, David R. "Education for the Nuclear Age--A Course in the Physics and Social Implications of Nuclear Energy." The Physics Teacher vol. 9 (1971): p. 461.

Kuhn, David J. "Science Education in a Changing Society." Science Education vol. 56 (1972): p. 395.

Liao, T. and Piel, E.E.J. "Let's Get Relevant." The Physics Teacher vol. 8 (1970): p. 74.

Linsky, Ronald B. "Educational Strategies for an Environmental Ethic." The Science Teacher vol. 38, #1 (January 1971): p. 16.

Mangum, Thomas E. and Mertens, Thomas R. "Introductory Ecology Courses in Colleges: A Survey." Amer. Biol. Teacher vol. 33 (1971): p. 484.

Marston, Edwin H. "A Course on the Physics of Urban and Environmental Problems." Amer. Jour. of Physics vol. 38 (1970): p. 1244.

"A new physics course is described that explores the interaction among science, technology, war, and military affairs since the 1930's; topics covered include the Manhattan project, weapons technology, strategic thinking, disarmament and government support of research. The course is part of a new interdepartmental 'Program for the Study of Peace and War.' We emphasize the valid role of general physics courses in studying areas where the results and methods of physics have an important impact on society."

Merry, Raymond W. "Science and Society--A Step Toward Relevance in Science for High School Students." The Science Teacher vol. 40, #2 (February 1973): p. 47.

Mester, John and Elza, Betty. "Science and Culture." The Science Teacher vol. 37, #7 (October 1970): p. 62.

Montag, B.J. "The Scene." Am. Biol. Teacher vol. 32 (1970): p. 335.

Thoughts on drug addiction and high school biology.

Morgan, M. Granger. "Topics in Technology and Modern Social Problems--A New Course for Science Students." Amer. Jour. of Physics vol. 40 (1972): p. 116.

"A pilot course is described that was designed to provide advanced undergraduate science students with an opportunity to explore the way in which several fields of science and technology interface with society at large. In addition, the course was designed to allow students to explore their interests and aptitudes for career work in the science-society interface area. Enthusiastic student response has led to plans to expand the course to a full year offering and suggests that similar courses would be well received by science students at other liberal arts colleges and universities in the country."

Naylon, Michael J. "Needed a 'Real World' Program of Environmental Education." Am. Biol. Teacher vol. 32 (1970): p. 404.

Novick, Shimshon and Sutman, Frank X. "A Socially Oriented Approach Through Carbon-Compared Chemistry." The Science Teacher vol. 40, #2 (February 1973): p. 50.

O'Connor, T.J. "'Science and the Future,' a Physics Course for all Academic Majors." Amer. Jour. of Physics vol. 39 (1971): p. 697.

Abstract of a paper presented at the February, 1971 New York City meeting of the American Association of Physics Teachers.

Phillips, W.B. Physics for Society. Reading, Mass.: Addison-Wesley, 1971.

[See review by Harold J. Metcalf, Amer. Jour. of Physics vol. 40 (1972): p. 787.]

Pilcher, V.E. "The Nuclear Power Debate--A 'Disputed Questions' Course." Amer. Jour. of Physics vol. 39 (1971): p. 1115.

Abstract of a paper presented at the June, 1971 Beloit, Wisconsin meeting of the American Association of Physics Teachers.

Priestly, Herbert. "Interrelationships of Science and Society--A High School Teacher Institute." The Physics Teacher vol. 10 (1972): p. 261.

Robinson, Buel C. "Science-Humanities Seminars." The Science Teacher vol. 39,#10 (October 1972): p. 41.

A description of a special series of school-wide seminars given at Washington High School, Denver, Colorado. [See pp. 18-19 of this Newsletter.]

Roeder, John L. "A Humanistic Approach to Science." Amer. Jour. of Physics vol. 40 (1972): p. 1615.

"A new course, in which the relationship of scientist to humanity as well as to science is investigated, is described. A selection of student reactions to the initial offering of the course is presented, and the possible role of the course in science education is discussed."

Romer, R.H. "Resource Letter ERPEE-1 on Energy: Resources, Production, and Environmental Effects." Amer. Jour. of Physics vol. 40 (1972): p. 805.

A descriptive bibliography.

Samples, Robert. "Science: A Human Enterprise." The Science Teacher vol. 39, #8 (October 1972): p. 26.

"The wave of so-called humanism, which swept across the nation and through the halls of the 1970 meetings of the American Association for the Advancement of Science, seems

to me to have distracted from the reality of the humanistic current that is buoying America upward. This pseudo-humanism is actually an anti-authoritarian movement which has little to do with humanism, and many radical despots have prostituted the banner of humanism to exercise a compulsion to destroy that which exists."

SESPA. Science for the People. vol. IV, #5 (September 1972).

The entire issue of this journal is devoted to "Science Teaching from a Radical Perspective."

Showalter, Victor. "The FUSE Approach." Munn, Robert. "The British Open University Approach." Romney, William. "Integrating Science and Social Science." Gardner, Marjorie. "Modules and Minicourses for Integrated Science." Hayward, O.T. "Integrated Science--The Untidy Field." Hilton, Alice Mary. "Cybernetics and Cybernation." Geisert, Paul. "The Greening of Science Teachers." The Science Teacher vol. 40, #2 (February 1973): pp. 25-43.

Contributions to a Symposium on Integrated Science Education at the school level.

Socolow, Robert H. "Teaching and the Environmental Challenge." Physics Today vol. 24, #12 (December 1971): p. 32.

Swant, Gary D. "Environmental Education in a Rural Setting." Amer. Biol. Teacher vol. 34 (1972): p. 518.

Uritam, R.A. "War, Peace, Science, and Technology in the Atomic Age--A Physics Course for the General Student." Amer. Jour. of Physics vol. 40 (1972): p. 1324.

"A physics course for social scientists is described. It presents the physics usually taught in a physical science course for liberal arts majors within the context of several urban and environmental problems. The problems considered include transportation, air pollution, thermal pollution of water, and scarcity of resources. They are analyzed in a physical, quantitative way, but in addition the legal, political, and social aspects are presented and discussed.

Verschuur, Gerrit and Wentzel, Donat G. "The TGEA--A New Educational Venture of the AAS." Bulletin of the American Astronomical Society vol. 4 (1972): p. 405.

Report on the formation of the Task Group for Education in Astronomy whose mission is to encourage the appreciation of astronomy by the public.

von Blum, Warren P. "Biology and Society: a Curriculum Proposal." Amer. Biol. Teacher vol. 33 (1971): p. 208.

Ward, Cynthia V.L. "Use of Opinion Polls." Jour. of College Science Teaching vol. 1, #4 (February 1972): p. 47.

A description of an experiment with the use of opinion polls on science-society issues in a course in chemistry for non-scientists.

Wentzel, Donat G. "Science Education: A Case for Astronomy." Amer. Jour. of Physics vol. 39 (1971).

"An astronomy course can demonstrate to the non-scientist that science is a human endeavor, involving social judgments and philosophical implications as well as established facts."

White, Roy C. "The State of the Art of Environmental Education." The Science Teacher vol. 37, #8 (November 1970): p. 41.

Wigley, E.J. "The Technological Approach." The Physics Teacher vol. 10 (1972): p. 8.

Winkel, Gary H. "The City is a System, is a System, is a System...." Overcash, J. Rosson. "Environmental Study in the City." Slesnick, Irwin L. "Population Education--A Response to a Social Problem." The Science Teacher vol. 38, #2 (February 1971): pp. 16, 18 and 21.

Three articles in a symposium on "The Ecology of the Cities."

VI. Bibliography #3 on Public Conceptions of Science (April, 1973)

The list of books and articles which follows updates Bibliographies #1 and #2 (Newsletters #1 and #2 of October 1972 and January 1973 respectively) by citing articles and books which we have come across since the earlier compilations were made, as well as several which have been suggested by Newsletter readers. Entries continue to be classified according to the following scheme:

I. Items relating to the assumptions, ethics, goals and general world view of science, and to public attitudes towards it.

II. Items relating to the applications of recent advances in science and technology, and to government science policy.

III. Items which attempt to explain or defend science, technology, and the scientific endeavor, or which deal with modes of communicating science and technology to the public.

The current bibliography contains no items in Category IV (Advances in science and technology outside North America and Western Europe).

Two bibliographies which were not cited in Newsletter #2 may also be of some use to readers:

Caldwell, Lynton K. Science, Technology and Public Policy: A Selected and Annotated Bibliography. (Prepared for the National Science Foundation by the Program of Advanced Studies in Science, Technology, and Society, School of Public and Environmental Affairs, Indiana University; Bloomington, Indiana.) Vols. I and II: Books, Monographs, Documents and Articles in Journals (in English), 1945-57. Vol. III: same, 1968-70.

The Science of Science: Annotated List (1968). Available from Science Policy Foundation, Benjamin Franklin House, 36, Craven Street, London WC2, England.

I. Ethics, Goals and Rationality of Science; Attitudes towards Science

Alvord, David J. "Achievement and Attitude." The Science Teacher vol. 39, #4 (April 1972): p. 37.

A study of the relationships between achievement in science and attitude toward school.

Andersen, Hans O. "Developing Favorable Attitudes Toward Science." The Science Teacher vol. 38, #8 (Nov. 1971):p. 41.

Benfey, O.T. "The Scientist's Conscience: Historical Considerations." Bulletin of the Atomic Scientists vol. XXI, #5 (May 1956): p. 177.

A review of restraints placed on scientific work in Ancient India and in the Renaissance, with special reference to the contemporary situation.

Bohm, David. "Fragmentation in Science and in Society." The Science Teacher vol. 38, #1 (January 1971): p. 10.

"Science and technology are flawed activities, with detrimental repercussions on society, because they reflect a serious flaw in society itself: fragmentation."

Cox, James W. "Two Decades of Science Cartoons from The New Yorker." Jour. of College Science Teaching vol. 1, #2 (December 1971): p. 35.

The author begins: "It would be difficult to be a reader of The New Yorker and a science teacher without being driven to clip New Yorker cartoons to help teach science." He reproduces some of his own favorites, and cites others which he has enjoyed.

Dixon, Bernard. "A Plea for Biological Thinking." New Scientist vol. 57 (1973): p. 27.

"Man is part of an evolutionary process ... and this knowledge may allow us to illuminate human activities not usually considered from a biological viewpoint."

Elliott, Walter E. "Perceptions of Physics, A Study of California High School Physics Teacher Characteristics and Teacher-Student Attitudes toward Physics." Amer. Jour. of Phys. vol. 38 (1970): p. 1501.

Abstract of a paper presented at the June 18-20, 1970 Meeting of the American Association of Physics Teachers at the University of Wyoming.

Geisert, Paul. "The Greening of Science Teachers." The Science Teacher vol. 40, #2 (February 1973): p. 42.

"...science teachers are becoming interested in the specific question: What role does science play in the total value system of education? It was with some of these questions in mind that I set out to investigate the problem: What do students and teachers feel are the values that science teachers 'should hold' in order to be effective in today's ever-changing society?"

Goodstein, Madeline. "What Are Scientists Like?" Chemistry vol. 44, #8 (September 1971): p. 11.

Goran, Morris. "Should You Marry a Scientist?" Chemistry vol. 44, #4 (April 1971): p. 16.

Two articles on high school students' attitudes toward science and scientists.

Heisenberg, W. "Construction of Large Accelerators: Scientific and Political Aspects." Science vol. 179 (1972): p. 643.

An adaptation of a speech delivered at the 21st meeting of the Nobel Laureates at Lindau, Germany in July 1971. The author raises questions on the continuing efficacy of large accelerators in yielding basic physical insight, and touches upon some more general problems regarding the relationship of science and government.

Jensen, William B. "Caricature and the Chemist." Chemistry vol. 44, #11 (December 1971): p. 6.

An historical survey on public conceptions of the chemist as seen through caricature.

Jungwirth, E. "Scientists as People." Jour. of College Science Teaching vol. 2, #3 (February 1973): p. 24.

"How do students' images of the scientist develop from high school through college, and what discrepancies exist between the images held by college students and the scientists themselves?"

MacKie, Evan. "A Challenge to the Integrity of Science?" New Scientist vol. 57 (1973): p. 76.

A retrospective look at the Velikovsky affair.

McKinnan, Joe W., and Renner, John W. "Are Colleges Concerned with Intellectual Development?" Amer. Jour. of Phys. vol. 39 (1971): p. 1047.

"Is the unrest today in many universities caused by student evaluation of problems based upon emotion rather than logic? Do student claims that curriculums are irrelevant, trivial, and inadequate in terms of the magnitude of the problems facing mankind today have substance, or are these students unable to evaluate logically the structure and necessity of those curricula? These questions, together with suspicions voiced by various professors of science about the inability of their freshman students to think logically about the simplest kind of problems, led the authors to question whether or not most college freshmen do think logically."

Muller, Herbert J. "Reflections on Rereading Darwin." Science and Public Affairs vol. XXIX, #2 (February 1973): p. 5.

"I suppose few people bother to read him [Darwin], but if they do they might feel as I did. Here he was dropping a bombshell on his society, starting a great revolution in thought--and what a nice guy he was. How gentle, modest, humble. And how unlike the popular image of the scientist today as the cold-blooded wizard."

Myrdal, Gunnar. "How Scientific Are the Social Sciences?" Science and Public Affairs vol. XXIX, #1 (January 1973): p. 31.

"...there can never be, and never has been, 'disinterested' research in the social field, as there can be in the natural sciences. Valuations are, in fact, determining our work even if we manage to be unaware of it."

Rosenberg, Ann. "Black Panthers in and On Science." New Scientist vol. 57 (1973): p. 369.

Interviews with Curtis Powell, a biochemist, and Clark Squire, a systems analyst, both of whom spent 25 months in jail awaiting acquittal on bombing and conspiracy charges.

Skolimowski, Henryk. "Science in Crisis." Cambridge Review, January 28, 1972, p. 70.

"The period of the deification of science is over. We need a new idiom for science. Indeed we need perhaps the New Science which would be more compatible with the nature of human beings, with the nature of human society, and with the nature of nature."

Sorenson, Juanita S., and Voelker, Alan M. "Attitudes of a Select Group of High School Seniors Toward the United States Space Programs." Science Education vol. 56 (1972): p. 459.

Stronck, David R. "Attitudes on the Population Explosion." The Science Teacher vol. 38, #8 (November 1971): p. 34.

Report of a survey of biology teachers, college students, and high school students in Austin, Texas.

Wade, Nicholas. "Theodore Roszak: Visionary Critic of Science." Science vol. 178 (1972): p. 960.

Comments on Roszak's "attacks" on science based on an interview and on his books, The Making of a Counterculture, and Where the Wasteland Ends.

II. Applications of Science, and Federal Science Policy

Batisse, Michel. "Environmental Problems and the Scientist." Science and Public Affairs vol. XXIX, #2 (February 1973): p. 15.

"Not a few of today's environmental problems have come from the erosion of the traditions and the ethics of scientific research."

Cahn, Anne H. Eggheads and Warheads: Scientists and the ABM. Doctoral Dissertation, M.I.T.: 1971. (Published in limited edition by Science and Public Policy Program, M.I.T., Cambridge, Mass., 02139.

A detailed study of the scientists' opposition to the deployment of the ABM which includes considerable data on the political perceptions, attitudes and behavior of many of the leading participants in the opposition movement.

Clark, Robin. "Technology for an Alternative Society." New Scientist vol. 57 (1973): p. 66.

"Intriguing new ideas and practical developments are beginning to emerge from the widespread debates in recent years over pollution, global catastrophe, and the social role of science and technology." A description of the current activity in this area and the motives behind it.

Greenberg, Daniel S. "Don't Ask the Barber Whether You Need a Haircut." Saturday Review of Science vol. LV, #48 (November 25, 1972): p. 58.

"Government-picked science advisers have traditionally cheered on the developments of new technology. Today the fad of technology assessment reveals unhealthy ties between such experts and their pet programs."

Greenberg, Daniel S. "The Rout in Executive-Suiteland." Saturday Review of the Sciences vol. 1, #2 (February 24, 1973): p. 52.

"Scientific heads are rolling in Washington as the President begins his second term."

Maddox, John. The Doomsday Syndrome. New York: McGraw-Hill, 1972.

"...a critique of ecological extremism, a defense of economic growth, and an unfashionable endorsement of the resources of mind...." (from the review by Benjamin DeMott, Saturday Review of Science vol. LV, #44 (October 28, 1972): p. 77.)

Morison, Robert S. "Adjusting to Normal Times." Science vol. 178 (1972): p. 1045.

"The scientific world must now carry on, in ways more appropriate to sterner times, what was best about the age just past." An editorial.

Pugwash Continuing Committee. "Pugwash: Raison d'etre." Science and Public Affairs vol. XXIX, #2 (February 1973): p. 22.

Excerpts from a statement issued following the 22nd Pugwash Conference at Oxford, September 7-12, 1972.

Shapley, Deborah. "Jason Division: Defense Consultants Who Are Also Professors Attacked." Science vol. 179 (1973).

A review of recent and current attacks.

Smith, Alice Kimball. A Peril and a Hope: The Scientists' Movement in America, 1945-47. Chicago: University of Chicago Press, 1965.

Probably the best historical account of the initial post-war involvement of U.S. scientists, particularly physicists, in the political arena.

Strickland, Donald A. Scientists in Politics: The Atomic Scientists' Movement, 1945-46. Purdue University Studies, 1968.

An historical account of the scientists' movement for civilian control of atomic energy.

Thomas, Lewis. "Guessing and Knowing." Saturday Review of Science vol. LV, #52 (December 23, 1972): p. 52.

"The most intelligent and optimistic look since Hippocrates at where medicine should be heading."

Walsh, John. "Federal Science: Filling the Blanks in Policy and Personnel;" Wade, Nicholas. "Science Adviser's Exit: What Does it Mean for Science Policy?" Science vol. 179 (February 2, 1973): pp. 456 and 458.

Two pertinent items from the "News and Comments" section.

Watt, Kenneth E.F. "Will the Future Be Shaped by Rational Policies?" Saturday Review of Science vol. LV, #44 (October 28, 1972): p. 76.

Confessions of a futurologist.

III. Explanations and Justifications of Science; Modes of Communicating Science

Asimov, Isaac. "I Can't Believe I Saw the Whole Thing." Saturday Review of Science vol. LV, #36 (September 2, 1972).

Asimov's presentation of holography and its possible applications can be regarded as a model of good popular science writing.

Croome, Angela. "A Woman Presents Man's Great Endeavours." New Scientist vol. 57 (1973): p. 140.

An interview with Margaret Weston, Director of the London Science Museum.

Davis, Robert C. The Public Impact of Science in the Mass Media. Institute for Social Research: University of Michigan, 1958. (Available on microfilm from University Microfilms, Ann Arbor, Michigan.)

A report on a nationwide survey carried out for the National Association of Science Writers.

Ferreira, Ricardo. "Chemists' Involvement in Society." A series of historical articles published in Chemistry:

"Joseph Priestley." vol. 43, #10 (October 1970): p. 16.

"Stanislav Cannizzaro." vol. 43, #11 (November 1970): p. 12.

"Dmitri Mendeleev." vol. 44, #2 (February 1971): p. 18.

Heyn, Ernest. A Century of Wonders: 100 Years of Popular Science. New York: Doubleday, 1972.

"This book might have been more properly subtitled '100 Years of Popular Technology,' since it is concerned almost exclusively with inventions that have changed our lives over the past century, ...an unabashed celebration of gadgets and products, whipped up in honor of the 100th anniversary of Popular Science Monthly " (from the review by Joseph Kanon in Saturday Review of the Sciences vol. 1, #2 [February 24, 1972]: p. 70.)

Kendig, Frank. "Coming of the Metric System." Saturday Review of Science vol. LV, #48 (November 25, 1972): p. 40.

A good example of intelligent popular science writing.

Krieghbaum, Hiller. Science and the Mass Media. New York University Press, 1967.

This classical study, written from the point of view of a journalist, focuses upon the relationship of scientists to the media.

Oppenheimer, Frank. "The Exploratorium: A Playful Museum Combines Perception and Art in Science Education." Amer. Jour. of Physics vol. 40 (1972): p. 978.

"The role which museums can play in science education is discussed in general and with particular reference to the Exploratorium in San Francisco. We describe how art, an atmosphere of playfulness, and exhibits about the mechanisms of human sensory perception, have figured in the development of our museum. It is suggested that some of the objectives of interdisciplinary survey science courses can best be achieved in museum like settings where students and general public alike can gain firsthand experience with the fabric of natural phenomena."

Rees, Mina. "The Saga of American Universities: the Role of Science." Science vol. 179 (1973): p. 19.

An adaptation of the address of the Retiring President of AAAS presented on 28 December 1972.

Schufle, Joseph A. "Thomas Dillon: Chemist and Revolutionary." Chemistry vol. 43, #4 (April 1970): p. 19.

Sears, Paul B. "Reflections on Science Writing." Amer. Biol. Teacher vol. 34 (1972): p. 396.

Sullivan, Walter. "Writing Science for the Public." Physics Today vol. 23, #8 (August 1970): p. 51.

"As physics becomes more and more specialized, interpretation for the public becomes close to impossible; a professional journalist explains how he meets this challenge."

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