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By-Seaborg, Glenn T.

The Government-University Partnership in Graduate Education.

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The National Defense Education Act of 1958 provided the framework for broader federal support to education at all levels in 1961, 1964, 1965, and in the Higher Education Amendments of 1968. The pluralistic framework within which government support currently operates must expand as the demand for this support grows. Despite present stringency, there is reason to believe that the federal-university partnership in cultivating intellectual resources on the graduate level is a permanent one. Graduate schools could prepare for increased government involvement in the future by diversifying their resources through new forms of the existing partnership. In the field of science, this would involve university use of government laboratories, university-government cooperation in the management and support of large research facilities, and interinstitutional programs that are funded by both government and universities. As the partnership develops to include growing support for the arts and the humanities, both parties will have increased responsibility to ensure university freedom from excessive government regulations. Graduate schools will be challenged to preserve the quality of education in the face of strained academic resources and increasing numbers of students. Universities should provide outlets for constructive contributions of activists, thus keeping themselves intact and enhancing the continued success of the partnership. (WM)

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*Second Plenary Session: The Government-University
Partnership in Graduate Education
Wednesday, December 4, 7:00 p.m.*

PRESIDING: Joseph L. McCarthy, *Chairman, Council of Graduate Schools*
KEYNOTE SPEAKER: Glenn T. Seaborg, *Chairman, U.S. Atomic Energy Commission*

It is always easy, I find, to accept speaking engagements a year in advance. I am sure that many of you in the audience are familiar with the pattern. A friend invites you to speak at a meeting. The date is distant; the issues of interest are not really crystallized. You accept for reasons composed of approximately equal parts of a genuine interest in the subject matter, personal ego, and a pleasant feeling that the moment of truth is so remote that it may never come at all. At some point reality intrudes, usually in the form of a letter from one's host. The cloud that was only as big as a man's hand has grown to alarming proportions.

The original invitation and later the reminder, in the case of my present assignment, came from your president, my long-time friend Gustave Arlt. Professor Arlt advised me that among the matters affecting graduate schools that might be appropriately discussed here were the effect of selective service on graduate enrollments; the effect of federal budget cuts; the student rebellion; and the disadvantaged student in graduate school. Moreover, I had the impression that these were only openers; the challenge was unlimited. As I stand here, a veteran of scores of speaking engagements contracted a year in advance, I can discover no appeal from George Bernard Shaw's verdict: "We learn from experience that men never learn anything from experience."

In self-defense, and in accordance with custom, I have taken refuge in carefully limiting my discussion to those problems about which I fancy I have some knowledge. I am buoyed by the thought that you who occupy the academic shooting galleries know that you have much better first-hand knowledge of this imposing list of problems that I and, that you, in consequence, can readily believe that cowardice plays but a small role in my reticence. Sheer modesty, at least in this instance, is the compelling author

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of my caution. Furthermore, I note that you have competent speakers addressing themselves to each of these problems as part of your program for today and tomorrow.

It is, of course, a great pleasure to talk to an organization composed of so many former colleagues and long-time acquaintances, including my friend of long standing, your chairman, Dean Joseph L. McCarthy.

I have chosen to center my remarks on the government-university partnership, which I have observed continuously for a quarter of a century as a research professor teaching graduate students, as chancellor of a large university campus, as head of a major government agency sponsoring research, and in many advisory positions related to the policies of this partnership. I will also venture some views on a subject that relates to one aspect of the student rebellion; namely, the primary function of the university—and most specifically the graduate school—in a time of upheaval and of commands that it play new and demanding roles.

I should like to introduce my thoughts on the government-university partnership through a perspective that, while necessarily abbreviated and oversimplified, is persuasive to me in understanding the present and future dynamic condition of graduate study and research.

In the early days of the nation, education beyond the three R's was not a major concern of the people at large. Our ancestors were filling up a big, raw land. Communications were rudimentary. The methods available made the soil a hard taskmaster, and more often than not the livelihood was marginal. All hands were needed in the field and only scant resources were available for education. Public schooling usually lasted only for a brief childhood—and then only if a school was nearby. As the industrial revolution evolved, communications improved, and productivity in the factory and on the farm rose so that more of the young could be spared and supported in the classroom and for a longer time. Moreover, the industrial revolution demanded skills unknown to the field hand. Larger numbers of youngsters received increasing amounts of education.

In assistance to education, the federal government played little part until 1862, when the Morrill Act established the Land Grant Colleges. In accordance with the American character, the motivation was practical. The Act, basically a response to the Industrial Revolution, recognized that practical education was important to the national welfare. While the Land Grant Colleges provided an important framework for developing an egalitarian system of higher education, development and support remained almost entirely a private state and local matter for nearly a century.

The striking success of the mobilization of the nation's scientific manpower in World War II provided a turning point. For characteristically practical reasons—primarily the feeling of continuing needs in national

defense in a world of alarming new dangers—the American people undertook immediately after the war the support of basic scientific research through several federal agencies. In the bargain, although without specific provision, graduate teaching in science was supported. The nation backed into the support of education at the highest level.

While the primary initial motivation was the national defense, much more was and has become involved. As a nation we recognize our involvement in a Scientific Revolution. The cycle that emerged first in the Industrial Revolution is now accelerated and well-defined: new knowledge breeds new technology which raises and diversifies productivity which expands affluence; to breed new knowledge it is necessary to finance exploration and education at the most sophisticated levels. It penetrated the national consciousness that knowledge and cultivated brains drive this circular system.

Sputnik drove home another lesson, namely that the production of the most advanced brainpower is a national problem and a federal responsibility. The result was the National Defense Education Act of 1958, passed under the umbrella of utilitarianism by a Democratic Congress and signed by a Republican President. Although the original act was limited in objectives, it provided the framework for broadening national support to strengthen education at all levels. This has been done through federal provision made in 1961, 1964, 1965, and in the Higher Education Amendments of 1968. I understand you will observe the 10th anniversary of the NDEA in a symposium here. Although the NDEA cuts of last year were continued in fiscal 1969, I nevertheless believe the bipartisan passage of the 1968 amendments demonstrates a national faith in the importance of federal aid to higher education even in times of severe budgetary stress.

Parenthetically, the NDEA became law on September 2, 1958, two weeks after I took up my duties as chancellor of the Berkeley campus of the University of California. One of my early official acts was to appoint a faculty committee to consider the opportunities offered to the University by the Act. From this beginning we developed programs of scholarships, fellowships, language institutes, and modern teaching aids that are resources of continuing significance to the Berkeley campus.

But the record of federal support of graduate study, as well as education at lower levels, does not end with NDEA and the several federal agencies that support science and engineering. The measures I have cited were taken primarily for what appeared to be utilitarian reasons. Largely neglected in this history of federal involvement were the arts, the humanities, and the social sciences. It has been argued with considerable heat—and no little merit—that federal support has thus unbalanced the educational and intellectual enterprise. For many years I and many of my colleagues in

science have been arguing the same point. Science alone, although it is rich in humanistic values that are sometimes forgotten, is not enough for men and women in the Scientific Revolution. We need a consciousness of man's rich history and culture. We must produce men and women who can sense and describe through art, music, and literature the human experience in an age of science. We must redouble our effort to understand human behavior in all of its manifestations and to improve our methods of implementing, through knowledge and understanding, man's constructive and peaceful adaptation to changing conditions.

In 1965, finally, we took an important step in providing nourishment for neglected intellectual endeavors when Congress passed legislation establishing the National Foundation on the Arts and the Humanities. I had the privilege of serving from 1962 to 1965 on the Commission on the Humanities, whose report played a significant role in establishing the Foundation. This was a very important measure for strengthening the arts and the humanities, and as a scientist I was particularly gratified to take part in it.

The National Foundation on the Arts and Humanities is comprised of a Federal Council on the Arts and Humanities, a National Endowment for the Arts, a National Endowment for the Humanities, and National Councils on the Arts and the Humanities. Its purpose is to help support and encourage literary and scholarly pursuits and creative arts of the highest caliber. In the arts its interests include (but are not limited to) music, dance, drama, architecture, painting, sculpture, photography, graphic and crafts arts, industrial design, fashion design, motion pictures, television, radio, tape recording, and all the other arts related to the preservation, performance, execution, and exhibition of these major art forms. In the humanities it is concerned with our knowledge and understanding of literature, language, archaeology, history, the classics, religion, philosophy, and the preservation of our heritage in all these fields. This is indeed a lot of ground to cover, but the range of interests indicates, I think, the thorough consideration of the complex needs of our creative and intellectual life that has gone into the planning and activities of the Foundation.

It is true that modesty characterizes the initial financing of the Foundation. Yet it should be remembered that the same kind of restraint was practiced in the initial budgeting of the National Science Foundation—the first federal provision frankly directed at supporting pure science on a broad base. The first budget for the NSF, for the fiscal year 1952, was \$3.5 million, while the budget for fiscal 1969 is \$435 million. I believe the National Foundation on the Arts and Humanities, having an initial budget of \$10.75 million in fiscal year 1966, also will grow (although perhaps not at the rate that the National Science Foundation grew) and become an increasingly important force in our system of graduate education and scholarship.

Another effort to fill a vacuum in a major area is the support that the National Science Foundation has been authorized to give to the social sciences. The Foundation now has a Division of Social Sciences which sponsors research in anthropology, economics, geography, the history and philosophy of science, political science, sociology, and social psychology. Again, the support is modest, but I believe there is growing understanding that these fields must have stronger support.

My reason for this exposition of facts that are hardly astonishing to you is to lay the groundwork for some generalizations. The first of these is that, in my opinion, the federal-university partnership in cultivating intellectual resources is a permanent one. I believe this partnership, as well as support in the lower schools, is based on acceptance by the public, the Congress, and the Executive Department of government that the young are a national resource; and that the development of that resource through education to the highest levels can be neglected only at our peril. Whether the quantity and quality of higher education in both private and state-supported institutions is adequate or inadequate depends primarily upon the federal government.

My second generalization is that the framework for adequate federal participation, broadly, in educational support is now largely available. If the support is uneven and in places inadequate, we can take heart from the fact that most of the machinery is functioning, the precedents have been established, and past experience suggests growth in the future.

Third, federal support for education at the college and graduate levels is relatively non-political. The obvious need, as well as the successful example of support for science, has allayed, if not abolished, old fears of centralist control, and muted sectional problems and religious questions.

Finally, the dynamics of the Scientific Revolution—the cycle of accelerating scientific and technological power, increasing productivity, greater leisure, and the demands for higher skills—seem to me to guarantee not only the permanence but the increase in federal involvement. To this opinion I would add the view of Alan Pifer, president of the Carnegie Corporation, who early this year stated that he anticipated federal support might increase until by 1975 government funds will supply at least 50 percent of university budget needs. The Carnegie Commission on Higher Education, as a result of its study to which I shall refer in a moment, believes that the Federal share of the cost of higher education will increase from the present 20–25 percent to about one-third by 1975. While vast support must continue at the local and state levels, the national responsibility is clear and irreversible.

To some extent we can see in a few statistics how levels of education and sophistication are being driven upward at an accelerating pace. Between 1900 and 1960, enrollment for undergraduate students increased 14 times, while graduate enrollment increased 57 times. This growth in graduate

enrollment reflects the demand for more highly trained people. During the decade of the 1950's the total labor force increased by 17 percent, while professional and technical workers increased by 43 percent and managers, officials, and proprietors by 33 percent.

Not all of you will agree, I am sure, with my optimistic outlook on the federal-university partnership. In particular, there has been considerable gloom over the tapering off of budgets in the sciences at the graduate level. Many valuable programs have suffered from cuts in NDEA funds. The reasons for the slowdown are well known, but they bear repeating. Since I am most familiar with the financing of science, I will speak of the situation in this area.

Research and development enjoyed a dramatic and uninterrupted rise in federal financing starting after World War II. At one point it was estimated that if the rate of growth continued, by the year 2000 the budget for research and development would be approximately equal to the gross national product! On these grounds alone an adjustment was inevitable and should not have been cause for surprise. That the adjustment was necessitated by unusual federal financial problems, rising from Vietnam and domestic difficulties, has served to escalate the problems of the graduate schools. I believe, however, we are warranted in assuming that the present circumstances represent an unavoidable and temporary retrenchment. The present commitment is extensive, and the program generally has remained vigorous.

As federal support grows, the present framework will inevitably need to be broadened. The individual research grant or project, awarded on the merits of the proposal and the competence of the participant, should continue to be the basic form of support. Certain problems have already appeared or can be foreseen in these programs. This year the government, which traditionally has dealt with individual investigators, asked the central administrations of the universities to impose severe cuts on National Science Foundation funds for each campus. This action understandably caught the campuses unprepared, and contingency arrangements must be developed by mutual agreement between the partners to avoid administrative crises, whatever the cause, in the future. Also in the future, block grants and unrestricted funds will assume increasing importance; and national fellowships, awarded on a competitive basis, will play an important role. The universities do not have the administrative machinery to handle this and must prepare themselves to cope with the allocation of salary and other operating expenses, equipment, and construction funds under such a regime.

The present federal support operates in a pluralistic framework with many government agencies involved, and this has many advantages which should be continued. However, it has the disadvantage that comes with

the government appearing to speak, and actually speaking, with more than one voice. This unfavorable aspect and the serious problems caused by sudden reductions in financial support must be overcome by the introduction of more rational apparatus at the federal level. Also we need to establish a relationship between federal support for academic science and the emerging federal role in the overall support of higher education. I expect that increased coordination through a council or committee mechanism will be forthcoming soon, followed by the creation of a cabinet-level Department of Education.

I believe that in the years ahead ways will be found for stabilizing government financing of the universities to avoid shock treatment and also to provide for the moderate growth and funds essential for spontaneous creative initiative. A formula for science suggested by Dr. Donald F. Hornig, Science Advisor to the President, would provide a growth rate in research and development of 6 percent per year, plus a "sophistication factor" of 1 to 4 percent to take care of growing complexity of research and equipment. The 6 percent figure is roughly proportionate to the recent rise in the gross national product. The reasoning, and I think it is sound, is based on the nature of our society; since new knowledge and technology are essential to growth of the economy, a regular investment should be made, taking into account knowledge as a growth factor. I am persuaded that in time efforts to develop formulae for insuring stability in the whole spectrum of government financing of the universities will succeed. However, I suggest that the development of this expanded federal-university partnership in a manner satisfactory to higher education will depend upon university administrators and faculty paying much more attention than they do now to this important expanding partnership. Congressman John Brademas of Indiana, a member of the House Committee on Education and Labor, suggested in a speech earlier this year to the American Political Science Association that this might offer an opportunity for political scientists to make a contribution.

In particular, we need a broader rather than a narrower base of faculty consultation with government in these matters. In view of the rising significance of federal funds for the universities, such time will be well spent in achieving the most meaningful structuring of programs. Nor should faculty members be subject to criticism for taking part in these activities that are especially critical for the success of graduate education. If the field of science is any measure, adequate faculty participation on committees formulating policy for government-financed academic programs is salutary and has not led to discernible neglect of or deterioration of the participants' performance of their individual teaching responsibilities. The graduate teaching programs in science are sound and relatively free from criticism.

While the reasons for this are complex, significant credit can be given to sound policies emerging from committees populated by academic scientists.

One of the big problems in establishing a growth rate for basic research, like it or not, is determining the economic value of discovery. This is tending to become a basic need in the physical and biological sciences, perhaps also in the social sciences and to a lesser extent in the arts and humanities. In science new knowledge accumulates on the shelf for years, seeps into the culture and the bones of research, and may be catalyzed into technology by a discovery or series of discoveries having an essentially untraceable background. We are constantly asked for examples of practical applications of new basic knowledge—too often defined as a discrete discovery made yesterday that we can see plainly in a mousetrap built today.

A friend of mine was telling me recently about his efforts to pull together a few examples of this. Most discoveries cannot be computed in dollars and cents. But he had found one that had a tag on it—the discovery of plutonium, in which I was fortunate enough to participate, using E. O. Lawrence's cyclotron at the University of California, Berkeley. My friend told me that someone had computed the dollar value of the energy at present worth that could be derived from available U.S. uranium reserves, using the uranium-plutonium cycle in breeder reactors. The price was about fifty quadrillion dollars. My friend—keeping a straight face—went on to tell me that he couldn't allow me and my colleagues that much credit. He would have to assign large portions to Fermi and his colleagues for demonstrating the chain reaction, to the engineers (past, present, and future) who have a claim on development, to the AEC and to industry for their large capital investments, and to my predecessors whose work had created the possibility of the discovery in the first place. He also pointed out that another source of power, such as fusion, might come along to replace the breeder before we burned up all the uranium fuel. By the time he got through, he said deprecatingly that he could assign me and my colleagues only a few hundred billion dollars credit for the discovery. I think I was being kidded, but I'm not sure how.

Seriously though, the problem of quantifying the value of "spinoff" from basic research is not trivial. I look forward to the time when some group of economists, perhaps supported by a grant from the National Science Foundation, makes a breakthrough in establishing realistic criteria in this field. I do not suggest that all basic research will be conducted with the expectation of ultimate economic benefit; I expect that in much fundamental research the motivating force will not be utilitarian goals but will continue to be a search for a deeper understanding of the universe and of the living and inorganic phenomena within it.

While I believe the future of federal support for graduate research in

science—and in other fields as well—is reasonably bright, I think it is clear that the old days of 15 to 25 percent annual increases are gone. And I believe that both during the present period of stringency and what appears to be a future of modest growth, graduate schools can profit from expansion and diversification of their resources through new forms of the federal-university partnership.

In the field of science there is a rich potential in the use by the universities of government laboratories. The example of this with which I am most familiar and which probably represents the broadest present exploitation of this potential is the growing use for education and research by the universities, individually and through associations, of the extensive and often unique and expensive facilities of the AEC's national laboratories, and the opportunities are by no means exhausted. The numerous educational institutions associated with the Argonne National Laboratory, the Oak Ridge National Laboratory, and the Brookhaven National Laboratory have increased their participation in the programs of those laboratories. In addition, we now have cooperative arrangements for both nearby and somewhat distant colleges and universities to take advantage of the unique facilities of the Commission's Lawrence Radiation Laboratory at Livermore, California, the Pacific Northwest Laboratory in the State of Washington, the University of California Los Alamos Scientific Laboratory in New Mexico, the Savannah River Laboratory in South Carolina, and the National Reactor Testing Station in Idaho. In the use of these facilities by the universities, both the graduate schools and the laboratories benefit.

I attended in October a joint University and Federal Council of Science and Technology symposium, at which the potential of the federal laboratory-university relationship was explored in depth. This symposium, the first of its kind but certainly not the last, held in Washington, D. C., was arranged in large part by Dr. Allen Astin, Director of the U.S. National Bureau of Standards. Here I learned about the growing use for education and research by universities and colleges of the laboratories and facilities of the National Bureau of Standards, the National Aeronautics and Space Administration, the Smithsonian Institution, and the Departments of Agriculture, Interior, Defense, Commerce, and Health, Education and Welfare. Dr. Astin has expressed the view that this growing collaboration is to an appreciable degree an extension of the pattern so effectively developed in the national laboratories of the AEC.

An example that may serve as a model for the future in the government-university partnership was the formation of the Universities Research Association, Inc. This consortium, now consisting of 46 universities (including the University of Toronto), was formed to cooperate with the federal government in supporting and managing large research facilities. The

present plan for the Universities Research Association is for it to serve the AEC as a contractor for constructing the 200 BeV accelerator facility at Batavia, Illinois and for operating this accelerator center as a national facility available for the use of qualified scientists from any institution in the country. URA will strengthen both the national program in high-energy physics and the participation of the universities in that program. The university-based scientists and graduate students who use the National Accelerator Laboratory will provide a continual source of creative talent for high-energy-physics research, and the universities are assured of having a direct role in managing the Batavia facility. And when we consider the advantages that could develop from such an association between a government agency and a group of universities, the prospects that URA could assume responsibilities beyond the operation of the 200 BeV accelerator look very promising indeed.

Interinstitutional arrangements represent a growing and promising form of such government-university financing, otherwise unavailable, across the whole spectrum of graduate education. I recognize the differences in requirements from field to field; nevertheless, wherever extensive area or regional participation can be shown, the chances of federal support are enhanced.

As Eldon Johnson, Vice President of the University of Illinois, pointed out in last year's fall issue of the *Educational Record*, "There is a certain inevitability about this kind of interinstitutional cooperation. It is, so to speak, in the wind and emerges logically from modern society."

There are significant benefits to universities in such cooperation. There are the advantages inherent in economies of scale and in jointly sharing risks and collectively assuming responsibilities. As the size and cost of our national educational establishment grow, there is a compelling need to work out a more orderly division of function and a more efficient allocation of resources for developing specialized competence in the many rapidly growing areas of research and instruction. This is an imperative that is being increasingly emphasized by taxpayers and legislatures. Federal legislation and administrative guidelines now offer encouragement and authorize support for cooperative programs among universities, foundations, and agencies. Organizing resources into a common pool (such as arranging to share libraries, computers, and costly laboratory facilities and experiment stations) can bring together enough common effort to produce a "critical mass" for effective programs ranging over broad areas, such as marine sciences, environmental studies, urban development, and the simulation of large social and economic systems. I wonder if, for example, the URA model does not offer some encouragement to the social sciences and perhaps the humanities in the future establishment of large and powerful cooperative

computer centers? Through "long line" electrical connections much of the work could be done without the necessity of traveling to the center. Another example of the application of technology to the social sciences and humanities is the interconnection of libraries through television.

In such interinstitutional cooperation there are new and expanded opportunities for both faculty and students to take advantage of specialized training, financial assistance, and travel—all of these in addition to the experience to be gained by trying new ideas in the fields of educational research and methods, curriculum development, and interdisciplinary study.

Still another method for enhancing prospects of federal assistance lies in initiative in obtaining a portion of the funds for a project through private and state sources. Last year the Texas Agricultural and Mechanical University dedicated an 88-inch cyclotron of sophisticated design. I doubt that federal support would have been possible without a commitment of half the construction funds by state and private sources.

As the government-university partnership grows and expands into the arts and humanities, increasing responsibility is thrust upon both parties to insure university freedom. For its part, the government must exercise great restraint in the imposition of conditions and regulations. The university can encourage such restraint and maintain its independence in a number of ways. Foremost among measures that insure maximum university independence is the maintenance of excellence in government-supported programs. Through its review procedures, the government participates in this responsibility, yet the greatest burden remains on the university. I shall say more of excellence in a moment.

Another area of university responsibility lies in the expenditure of government funds. In this connection, government provisions have been written with liberality and under considerable influence from the universities. In effect, the universities have taken upon themselves most of the burden of responsibility; therefore, indifference in performance would be especially unfortunate. It is particularly important that appropriate administrative and academic officials be involved in continuing, substantive administration of federal funds. Review procedures must be rigorous and must not be allowed to decay into routine formalities. Consistent care must be exercised to be sure federal funds are expended for the purposes for which they are intended. Clearly, significant weakness in such procedures could inject unnecessary trauma into the federal-university partnership.

The growth of the cooperation between the federal government and the universities will place some additional responsibilities on this partnership. McGeorge Bundy raised an important point at the meeting of the American Council of Education last year. Bundy recommended that universities become more candid and less reticent about disclosing their financial affairs.

If it develops that our universities will have no choice but to seek large increases in level of support for both private and public institutions, then, as Dean Bundy says, these same "institutions will be held to a new level of accountability by federal and state agencies of government working at a new level of sophistication."

I have another suggestion about the good health of the university-government alliance as federal funds support new academic fields. The Congress and the Executive branches of the government have a need and a right to review programs supported by tax monies. They take this task seriously, as they should and as we all insist they do in all programs—except possibly our own. In the early days of government support of science, it was not uncommon for some of us scientists to be indignant about reporting to or appearing before a Congressional committee. Most of us learned early that this was a counterproductive attitude. The university and the professor have a great deal to gain by welcoming such interest. It is, indeed, an unprecedented opportunity to inform and educate sincerely interested responsible and influential individuals.

Obviously, large-scale dependence of universities on federal funds has its hazards. I believe that this should be a cause of concern but not of fear. I believe that the government-university partnership can be managed so as not to be subversive of university freedoms. But let me emphasize this: the greatest responsibility for keeping our universities free and self-reliant will rest with the universities themselves—with their faculties, their administrators, their trustees. The universities must see to it that their own standards of excellence and freedom are maintained in a period of growing relationship with government. From my knowledge of government, I feel strongly that this is possible if the universities adopt and maintain a courageous, firm, vigilant, reasonable and just attitude toward this partnership.

I believe the thrust of my remarks this far indicates I am convinced that the graduate schools, with government help, have an enormous challenge ahead of them in performing their primary functions. Those functions are, of course, to expand knowledge and to equip our best young people for creative work in a wide variety of disciplines. Under the best circumstances, these challenges test the finest academic minds of our country. The government-university partnership has succeeded in this effort beyond the fondest imaginings of a generation ago, and our institutions are in many ways the envy of the world. In the achievement of this success, our universities have been the irreplaceable source of the skilled people now coping with the difficult socio-economic and technological problems our society faces. The need for a continuing and expanding flow of sophisticated knowledge and skills is, and will be, very great. The substantive challenge

to the universities in the future can be defined in terms, above all, of maintaining quality in the face of rising multitudes of students and the strain on academic resources.

The quantity side of the equation is indicated by the recent report of the Carnegie Commission on Higher Education, headed by Clark Kerr of the University of California. The Commission, using figures from the U. S. Office of Education, Department of Health, Education and Welfare, traces and projects the growth of higher education. In 1956 there were about three million students in the colleges and universities, this year the number is about six million (on a full-time-equivalent basis), and in 1976 there will be some eight to nine million students pounding on the doors. While this new flood of students calls for establishing at least two new colleges (in large part, junior colleges) per week in the next several years, according to the Commission, in the academic year 1966-67 only 72 new institutions of higher learning were established in the United States. Provision is needed by 1976 for 75 percent more medical students and 60 percent more candidates for the Ph.D.

As for quality, the core of my own philosophy continues to coincide with the statement by the President's Science Advisory Committee on *Scientific Progress, the Universities and the Federal Government*, issued in November 1960, during my period of service on PSAC. In this report the Panel on Basic Research and Graduate Education, of which I was chairman, stated: "In science, the excellent is not just better than the ordinary; it is almost all that matters. It is therefore fundamental that this country should energetically sustain and strongly reinforce first-rate work where it now exists."

The Panel report also speaks to a parallel challenge that will remain with us in the next decade, and I quote: "It is of equal importance to increase support for rising centers of excellence." This is required not only to solve the problem of quantity and quality of educated men and women but also to meet the growing requirement of a government run by representatives that federal support for higher education must pay some attention to geographical distribution. A number of government agencies have adopted funding policies designed to create such new centers of excellence. For example, the National Science Foundation has its University Science Development Program, and the Atomic Energy Commission, the National Institutes of Health, the National Aeronautics and Space Administration, and the Department of Defense have programs designed to advance this concept.

There are, of course, problems in meeting this challenge. We need to establish the needed centers of excellence in new geographical areas without tearing down established ones in the face of our increasingly difficult

budget situation. We must prevent the competition for establishing new centers in various regions from deteriorating into a science pork barrel. Considerable wisdom and restraint, combined with new money, will be required so that national support for excellent yet reasonably distributed graduate institutions does not degenerate into the parochial situation where no congressional district is complete without a post office, a reclamation project, and a new science laboratory.

I would also like to repeat another fundamental contention of this report because of its special relevance to this audience and because I feel that it is so important to emphasize in connection with current discussions concerning the role of graduate schools. The Panel stated and emphasized that the process of graduate education and the process of basic research belong together at every possible level. The two kinds of activity reinforce each other in a great variety of ways, and each is weakened without the other. I believe that this concept is basic to the graduate school.

At the beginning, I said I would speak on a subject that relates to the turmoil now afflicting some of the campuses of the nation. As we face the test of maintaining quality for the multitudes, the challenge to the graduate schools is magnified by the problem of turbulence on some of the campuses, within which there appears to be a struggle over the primary responsibility of, as well as for, higher education. This turbulence has provoked considerable thought.

The seriousness of this conflict was underlined by Dr. Frederick Seitz in his role as president of the National Academy of Sciences, who said in university lectures and in the autumn 1968 issue of the *American Scientist* that prior to 1960 he would have expected, and I quote in part, "the universities to become in effect as centrally important to our society as cities, being the major trading centers of our intellectual and innovative life." Professor Seitz adds that in the light of the present social struggle on the campus, and in the event of its prolongation, he has significant doubts about this outcome. Professor Seitz continues, "The universities are poorly equipped to maintain their productivity in both breadth and depth as they attempt to cope with this complex struggle." Professor Seitz speculates on a variety of results of this struggle if it continues indefinitely. One pattern might resemble some European forms: the universities may turn into extensions of secondary schools in which basic disciplines are taught and rudimentary experience is gained in the research process; and the advanced schools would be detached or new institutions established to provide protection against campus turbulence. A less radical outcome, according to Professor Seitz, might be a pattern of academic institutions to induce selective specialization on campuses in order to permit like minds to flock together. Still

another alternative, he foresees, is the development of universities specializing in graduate work, much as the medieval Italian universities did.

The genius of the American university and its superiority over the European system, in the view of many scholars, lies in its breadth, its integration under one roof of the diverse disciplines of learning and research. The fragmentation of the universities would have, I believe, damaging consequences for education and for society at large. Fragmentation would exacerbate the two-culture syndrome to which C. P. Snow has called attention; our need is for unity rather than isolation. It is not beyond imagining that liberal arts universities oriented primarily to social problem-solving would suffer in financial support, with subsequent reductions in the quality of the advanced institutes, which would already be risking much from the inherent dangers of isolation and narrowness. As an educator and as a participant in some of the policies supporting federal aid to higher education, I find no merit in policies that would lead to dismemberment of the universities.

I would not have you think these views suggest that I believe in ivory towerism. I am one of thousands of members of the academic community, including many in the audience, whose work refutes the notion that the university has been remote from the world in recent years or that it can be in the future. In a wide variety of roles and at many levels of social organization, academic people contribute their knowledge and energies to the solutions of social and technical problems. In my case, I am on leave from the University of California as professor of chemistry. For these past eight years, as Chairman of the Atomic Energy Commission, my major concerns have included efforts to provide adequate sources of energy for a highly technological, energy-consuming world of the future, and to find the means for establishing a stable peace.

Surely the universities should be, as they are and have been, involved in the solution of society's problems. Indeed, since the federal government has basic responsibilities for such solutions, the federal-university partnership appropriately strengthens the direct coupling of the universities to social issues. By its nature the university has unique knowledge and resources to contribute. To date, the university has succeeded in making these unique contributions by its very attention to priorities based on first principles. These principles, I believe, hold that the university's first duty is excellence in the expansion of knowledge and in the teaching of the young, and its second is to contribute to society through its able graduates and in such other ways as do not imperil its first obligations.

I have no doubt that participation in the solution of social problems by faculty and graduate students can be expanded, especially in the social sciences, and in the context of scholarly endeavor. In this regard we should

perhaps note that the Urban Coalition, under the leadership of John W. Gardner, former Secretary of the Department of Health, Education, and Welfare, emphasizes the necessity of the university's joining with business, professional people, the clergy, and ghetto representatives in seeking solutions to urban problems. An interesting response to the call for increased involvement of this nature is the program proposed by President Charles J. Hitch, of the University of California. President Hitch has initiated an inventory of University resources that may contribute more, in appropriate ways, to the solution of urban problems. He has also proposed the reorganization of University Extension so that this organization can transmit "the thought and research of the campus directly to the heart of the city," in a manner analogous to the historic and productive function of Agriculture Extension. This appears to be a promising approach.

However, for the universities to yield to extreme commands that they become *primarily* direct social-action agencies would appear to be self-defeating. It does not seem likely that the university has the resources or the tactical position in the social structure to undertake the central role in solving complex social problems directly. But what is more important, the attempt could weaken or destroy its unique primary mission. One also suspects that there will continue to be an abundance of social problems in 1990 and the year 2000. Will the universities have produced the knowledge and the multitudes of skilled men and women to solve those problems? Or will the universities have decayed into intellectual stagnation by one of two unhappy routes: through the dominance of internally generated political activism over intellectual achievement; or through the imposition by an alarmed public of repressive political restrictions?

At this point, I am reminded of the line of McLandburgh Wilson, who wrote:

Twixt the optimist and pessimist
The difference is droll:
The optimist sees the doughnut
But the pessimist sees the hole.

I have always been one to see more of the doughnut than the hole. Thus, I am inclined to believe the present abrasiveness of campus conflict can be diminished before serious harm is done to the academic community. I claim neither clairvoyance nor evidence for this point of view. I am persuaded to it mainly by the past. Our institutions have demonstrated considerable strength and resilience. So far they have been able to limit and absorb extremism and on occasion to benefit from the experience.

I am confident that faculties and students will solve current vexing

problems in ways that will keep the universities intact and be consistent with the expansion, improvement, and continued success of the government-university partnership.

I say this without complacency and with the realization that the present test lies ahead. The genius of our institutions lies in their capacity to embrace reasonable change peacefully. In general terms, our task is to approach with intellectual honesty and moral courage the deep-rooted problems that lie at the base of today's ferment; problems that, unsolved, provide ammunition for the extremist. I think we can concede the validity of much that troubles thoughtful young people today. They see a world of immense potentials for material productivity inhibited by inertia in patterns of distribution, of affluence existing adjacent to poverty, of knowledge and concern amid ignorance and indifference, of political turmoil and philosophical upheaval. We should honor the young for recognizing our paradoxes and perceiving barriers to our potentials. We can sympathize with their idealism, with which we ourselves identify, and with their concerned desire to influence change. Our defense against destructive apocalyptic solutions is to effect demonstrable change where it is called for and to show the young that they can influence the course of events through participation in our institutional processes. Students and recent graduates are indeed finding that our institutions offer extensive outlets for implementing their ideals. For every confrontationalist there are scores of students who join the Peace Corps and VISTA and who engage part-time in a wide variety of educational projects to help the disadvantaged. The opportunities for rewarding action will grow, I believe.

As serious students find increasingly that there are serious ways they can make serious contributions to the solution of serious problems, the hyperbolic activist will give way to the constructive commitment from which progress flows. In the universities we are seeing the establishing of new channels of communication between students, faculty, and administrators.

The current turmoil may turn out to have some benefits which in the daily life of a harassed dean are, to understate the matter, obscure. Perhaps we are learning from students some new ways of improving and enriching the university experience.

I cannot resist the temptation to comment on what seems to me to be a paradox in some of the apparent attitudes of activist young people. For whatever reason, we frequently perceive an anti-science posture in today's politically active students; and one sometimes receives the impression that the virulence of the affliction rises with the degree of activism. This is curious. Consider the extent to which our young people for the most part are products of science—their years of good nutrition, their

protection against disease with modern drugs, their freedom from the youthful drudgery that was the lot of every previous generation, the gift of time for extended educational experience, the institutional material resources available, the very content of knowledge and perceptions that permeate the body of modern intellectual thought. Yet many young people have managed to escape understanding what a powerful tool science is for improving man's well-being.

My purpose is other than to ask the young to exude gratitude for the blessings of science. If I read the signs correctly, the anti-science posture derives from the obvious fact that new knowledge can be misused. If the analysis is limited to this perception, as it often is nowadays, the analyst deprives himself of considerable power. One might as well—or even more appropriately—be hostile to a baby as to science, for surely there is nothing potentially more dangerous. The baby, after all, can grow up to be heroically evil and destructive, since he is the potential instrument for the perversion of knowledge. We approach the baby rationally—we study him and his development and try to influence his maturation.

Science is not a baby, of course, but I believe there is some value in the analogy. We have good reason to study science. One lesson to learn is that it is man, not science, who misuses knowledge. Identification of the right target seems to me to be very important in making improvements in the achievement of a peaceful world. Another important lesson is that the study and understanding of science—its processes, potentials and power—would appear to be essential for young people who wish to influence the world in the direction of their ideals. Do they know that we are on the verge of revolutions of greater magnitude than any in the past—revolutions more powerful than a few of the young hope to achieve in the streets? Do they comprehend the implications of the deciphering of the genetic code for the hereditary characteristics of human beings of the future? Do they understand that we stand in the shadow of an era of unlimited nuclear energy generation and of a capacity to realize the dreams of generations of idealists—the material well-being for the people of the earth? Does the activist idealist know that he can achieve his ideals only through science and technology?

Nor is the value of science limited to the material. No less important in the equipment of an effective modern idealist is an understanding of the unique philosophical, aesthetic, and moral values of science. In an age of science, can a set of values be relevant that excludes science? For those who seek and would act upon the basic truths, can the magnificent truths being revealed by science be ignored? Can the young idealist fashion our future without a mastery, not of the details, but of the philosophical

and moral implications of science that so powerfully affect the human future?

The acquisition of the skills and knowledge the young idealists will need to influence the future and to be philosophically attuned to the modern world cannot be gained easily. It takes very hard intellectual effort. It would require for many a redistribution of energy and work. But the results would be, I believe, rewarding both to the individual and to society.

I would like to close with a few words on what I believe the future role of the universities can be. I believe the universities can occupy an increasingly central role in society. To some extent the universities have been serving the needs of an industrial society which has been only partly and indirectly of their making. In the future I see the possibility of our universities, especially our leading graduate schools, substantially shaping the goals of society. Not that the world will be ruled by a handful of professors. Rather, I believe, society will find merit in the ideas and values generated in the universities. And thus universities will shape the educational experience from the earliest years through the full lifetime—a broad experience equipping the individual for maximum intellectual achievement and a capacity to live with man, machines, leisure, and change. As Robert Theobald suggests, education in the age of the Cybernetic Revolution would not be directed toward “earning a living” but toward “total living.” In the achievement of such ambitious goals, we look to the graduate schools for leadership.

I have talked to you this evening from the perspective of one who has had some participating experience in the area of graduate education and research, as a university administrator who had to deal with this area during a time of changing government-university relationships, and finally as a government official who has had much to do with the support of university research and graduate education. I hope that I have succeeded in synthesizing from this experience a point of view that will be useful to you.