Policy Analysis

# Cato Institute Policy Analysis No. 22: He Who Pays the Piper: Federal Funding Of Research

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Don Doig

Don Doig is an associate policy analyst of the Cato Institute with a background in microbiology research.

**Executive Summary**

A groundswell of discontent has arisen in the U.S. scientific community, fueled by uncertainty of federal funding, censorship, red tape, and assorted other ills. In 1979 one observer noted, in an editorial in *Science* magazine:

> During the past 2 months I have had casual conversations with about 20 professors from widely scattered universities. If their attitudes are an indication of the spirit on campus, the long-term future of science in America is in jeopardy. Not one of those 20 conveyed the impression that life is great, science is fun, and that academic research is the best possible of all activities. Rather the majority were gloomy -- some were bitter. How could such individuals inspire the young and foster in them a love of knowledge and a zeal for lifelong scholarship? [1]

Not too long ago, a sense of euphoria and opportunity pervaded the research world; funding was increasing rapidly, scientists encountered minimal red tape, and research departments were expanding. What has happened? Recent years have seen expanding involvement of the federal government in the funding of basic research, and with this involvement has come bureaucratization and politicization. Scientists and administrators within the research community have increasingly expressed alarm at this development. Researchers yearn for the halcyon days when ample resources were forthcoming from the government and regulation was relatively light.

Following World War II, the federal government began to provide significant support for university research. Federal involvement increased dramatically when the Soviets gained the lead in the space race with the launch of Sputnik. Policy-makers wanted to enhance the size of America's research efforts to provide a better basis for technological and military expansion to counter what they perceived as the Soviet threat.

The university and research communities in the U.S. probably should have viewed this largess with some skepticism, incorporating as it did the centralization and militarization of science. It is difficult to reconcile the ideal of an unfettered pursuit of knowledge with the demands of a defense establishment intent on utilizing science and technology in pursuit of military superiority, or with the demands of a democratic society for accountability for the use of federal funds. Former President Eisenhower, in his famous warning against the dangers of the military-industrial complex, went on to describe the pernicious effects of federal funding of science: "The prospect of domination of the nation's scholars by federal government project allocation, and the power of money, is ever present, and is gravely to be regarded."[2]

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**Funding: Federal vs. Private**

Nevertheless, university administrators initially viewed federal funds as resources which could better support research and graduate education activities which they would have had to support anyway.[3] Relatively few strings were attached to these funds, and the money was used for the direct costs of the research and for graduate education. In recent years, however, federal research grants have evolved particular patterns of control which differ significantly from other forms of disbursement rules, such as those attached to foundation grants.

Institutional grants tend to be programmatic, while federal grants and contracts are awarded on a project basis for individual scientists. Private grants from industry or foundations also allow flexibility in research objectives because they typically allow a more generalized approach with minimal red tape, compared to federal projects. As an example, the University of Illinois chemistry department receives annual grants from E.I. duPont de Nemours & Co. The department head controls the disposition of the grants, and DuPont requires only that projects be relevant to the general purpose of the grant. Neither applications nor financial reports are required. The director of the School of Chemical Sciences describes the procedure:

At the end of the year, a brief report is submitted "giving a general description of how the funds were used" and commenting perhaps on future needs The red tape is minimal because DuPont has a continuing basis for evaluating the department's performance -- the abilities, qualifications, and numbers of our graduates they employ.[4]

Grants made by the Sloan and Dreyfus foundations differ in detail but involve little red tape and permit broad discretion in expenditures.[5]

The John D. and Catherine T. MacArthur Foundation awards no-strings-attached fellowships of $50,000 a year for periods of from 5 years to 20 years. The grants require no applications, project outlines, or reports. J. Roderick MacArthur explained:

The idea behind the MacArthur Prize is that Einstein could not have written a grant application saying he was going to discover the theory of relativity. You can't write a proposal saying you're going to discover something you don't know exists. Einstein needed to be free, and so do future Einsteins.[6]

Federal research grants, on the other hand, are awash in red tape and bureaucratic oversight. Lengthy, detailed applications are required, which are subject to peer review. In 1960, the prominent intellectual Leo Szilard suggested, at a time when federal support of research was growing, that scientific progress could be effectively halted by instituting a competitive grants system such as now exists. In 1978 a total of about 47,500 proposals were submitted to the various federal agencies.[7] Researchers under such a system must describe their projects and goals. One estimate is that at least three weeks is spent writing each proposal (it can take as long as three months, or even three man-years for group proposals). The review process adds another three mandays per proposal, for a total of 575 man-years spent on review. This is time spent by leaders in the field, time presumably taken away from productive research. The total time investment (writing and review) is approximately 3,300 manyears of research time. But since most university researchers spend about half their time teaching, this figure may represent the entire equivalent research time of 6,600 academic scientists. On top of this, grant applications are rejected from 60 to 90 percent of the time (depending on the program), with a more typical range of between 70 and 85 percent. If a grant is approved, progress reports can require an equal amount of time. One study estimates that proposal and progress report writing reduce research output by one paper per year per faculty member, or a 10 to 20 percent loss in research output.[8]

Another problem with current federal grants is that new, innovative areas of research "fall between the cracks of federal funding, which follows traditional lines."[9] Scientists must be free to follow leads as they develop, to change direction as new opportunities present themselves. Unfortunately, the "strict compartmentalization of the [federal]

funding organizations [makes] it very difficult for a scientist to follow the direction that research takes."[10] Federal grants attempt to "target" basic research to purchase specific research results. The auditing and regulatory functions of the federal bureaucracy are increasingly being applied to the delicate and sensitive process of basic research, further limiting creative flexibility and stifling innovation. One physicist comments:

Ostensibly these [functions] are to prevent fraud, but most research institutions already have safeguards to protect against this very rare abuse. In reality, the bureaucratic drive for uniformity seems a more likely explanation for the narrow auditing perspective imposed on the scientific researcher.[11]

Given the need for freedom in lateral movement, to follow new opportunities as they develop, which makes possible the development of many "breakthrough" ideas, funding institutions have to be flexible. As a safeguard, "the basic researcher...operates in a highly competitive environment with many colleagues standing on the sidelines, eager to substitute for him if he falters. If he succeeds, continued funding and intellectual satisfaction are his reward. If he fails, he'd better look for another career."[12] As it is, competent, creative researchers are often forced to "bootleg" their research.[13] The case of Leo Szilard is a good example.

When Szilard applied for grants he always proposed to do experiments that he had in fact already done, so that he could use the money for research whose outcome he could not predict. The system worked perfectly until one year his application was rejected on the grounds that the proposed experiment was impossible.[14]

The peer review system has been criticized as an old-boy network prone to nepotism and favoritism.[15] Others have defended it, claiming that available evidence indicates that grants are distributed equitably.[16] And still others argue that there is a large element of chance in successful grant applications, indicating substantial disagreement among reviewers.[17]

Clearly, there is potential for abuse; more importantly, the peer review system may inhibit innovation. Thomas Kuhn has discussed the mechanism of scientific "breakthrough" discoveries as shifts in the fundamental framework of analysis, or "paradigm" shifts.[18] Paradigm shifts typically encounter resistance from representatives of the "establishment" viewpoint, not usually out of dishonesty, but because they have difficulty in accommodating a new view. Researchers sitting on peer review panels will, understandably, view grant proposals from within a particular paradigm. And it would not seem unreasonable to suppose that grant proposals falling outside that framework will have difficulty getting funded.

The compartmentalization of funding agencies, the political accountability of agency bureaucrats, and the resultant tendency to fund "safe" research also inhibit speculative funding. It becomes clear, then, that federal agencies will tend to implement policy destructive of innovation. One member of a funding agency is reported to have said: "We admire innovation, but we don't trust it. And we fund what we trust."[19]

**Funding Fluctuations**

Basic research, moreover, is sensitive to uncertainties in government funding, since long-term planning is a necessary component of many experiments, and long-term career choices and morale are affected by fluctuations. As government priorities change, large fluctuations in research and graduate education funding can routinely be expected. Depending on administration biases or public pressure, certain research fields will periodically experience boom-and-bust funding. In recent years scientists have migrated to cancer and energy research.[20] In 1970, the National Cancer Institute (NCI) became the focus of a massive campaign to conquer cancer in time for the Bicentennial, to be managed by highly political committees answering to the President. As it turned out, the cancer crusade only furthered NCI's monopoly on cancer research, besides spending $9 billion. NCI now controls between 75 and 90 percent of all cancer research money.[21] The Reagan administration has favored large increases in defense research and development (R&D) spending, fairly constant funding of basic research, and major cuts in social, behavioral, and economic science funding (at least in 1981 and 1982; 1983 will see partial restoration of some funds).[22]

Universities have trouble responding to such rapid changes and attempt to resist cuts. During the period of post-Sputnik expansion, more Ph.D.s were trained than the research and university systems can now absorb, given stabilized research budgets. One analyst calculated that the growth in graduate training and research funding during the 1960s

resulted in the overbuilding of university capacity, laboratories, and faculty by at least 25 percent.[23] In response to federal funding, universities have now overextended themselves. One result has been an incentive to increase overhead charges on federal research grants -- pushing indirect cost charges to the limit, draining resources intended for research, and increasing federal demands for grant accountability. This has led, in turn, to a federally-mandated bureaucracy in university business offices.

**Science and Bureaucratization**

In 1979 the federal government imposed further bureaucratic controls on the research community. A new Office of Management and Budget circular [24] called for a complete report on all salaried activities of scientists who spend any time at all on federally-funded work.[25] Scientists have not responded favorably. The National Academy of Sciences passed a resolution in 1980 which reads in part:

Application of these new regulations to institutions of higher learning would further constrain the already limited flexibility in research thrust, increase the administrative burden, reduce morale among teaching and research personnel, and provide a cumbersome, meaningless documentation in terms of percent-of-effort for a continuum of scholarly activities. Moreover, because these regulations would monitor non-federally supported academic functions as well, inappropriate controls might be exercised.[26]

This rule is clearly invasive of academic freedom; it attempts to monitor university teaching and independent research, even though they are not federally funded. The complex relationships between research and teaching render the regulations meaningless in terms of accountability. Diversion of resources to bureaucratic accounting under the rule is likely to waste more than would be saved and depress morale still further. MacLane sums up the problem:

[This rule] is meaningless, invasive, inappropriate, counterproductive, and ineffective... such total reis not in keeping with the character of the university; the university does not consist of a set of faculty employees whose time is bought by the administration, but is rather a group of scientists and scholars engaged in free and independent inquiry.[27]

It seems obvious, then, that controlled bureaucratic management is incompatible with excellence in scientific re search. Since bureaucracies are compelled by an internal agency logic to expand their active regulatory roles, an inevitable conflict is generated. Bureaucrats, however, cannot be assumed to be acting out of bad intentions. For instance, Elmer Staats, the former U.S. Comptroller General, recognizes the nature of basic research:

The keystone of the research process, however, is the individual researcher or the generally small group of researchers who perform the work. The process of investigation itself, like the overall "climate," is characterized by a lack of hierarchy. The researcher conceives, directs, performs, and publishes his work, often in conjunction with graduate students, who are essentially practicing apprentices. He is his own director, his own boss. He has a heightened sense of self-reliance and autonomy, and this serves as crucial motivation for his work. As a consequence, a researcher will be particularly sensitive to any externally imposed constraints on his time and investigative effort.[28]

The detrimental effects of bureaucratic management are an inevitable result of centralized political resource allocation and will not be effectively addressed by finding competent administrators or right-thinking politicians. Economists have demonstrated the impossibility of rational resource allocation under central political control and the perverse institutional incentives which work to subvert good intentions.[29]

Bureaucracies are comprised of individuals who naturally seek to enhance their professional standing. This is achieved by increasing their discretionary control over resources and the size of their staffs. This tends to increase their salaries and their personal power. As a result, institutional incentives lead inexorably to the growth of the bureaucracy. But since bureaucrats are more concerned with increasing their access to funding, they are not particularly sensitive to the effects of their actions. Bureaucrats do not personally bear the costs of their actions, nor reap the benefits. As a result, rules and regulations fit the objectives of Congress and the funding agencies, not of research. Gutowsky noted that

the federal granting agencies are not service oriented; in fact their clientele consists mainly of supplicants for funds who find it hard to be critical of an agency. Why bite the hand that feeds you? Moreover, the views of applicants and grantees are seldom sought.[30]

Additional federal regulations contribute in a myriad of other ways, sometimes minor, sometimes significant, to the costs of research projects and university administration. The cumulative effect is devastating.[31] These regulations cover everything from equal employment opportunity, animal colony standards and recombinant DNA research, to fetal research. As is typical of federal regulations, the costs of these regulations -- in time, money, and lost opportunities -- are rarely considered.

**Political Control**

If there is substantial frustration and waste associated with the funding of science by bureaucratic agencies, and little prospect of effective reform, the major long-term problem has yet to be discussed. It is a problem not confined strictly to basic research; it touches on education and technological research. Our concern should rightly be focused on the question of the integrity and independence of research and education in the United States, and on the effects of politicization of university funding. In nearly 30 years of federal involvement, the government increasingly has moved to impose political control over universities. Philip Handler, president of the National Academy of Sciences, in congressional testimony noted: "I suppose that university presidents have always known that he who pays the piper will one day call the tune... [Now], while avowedly only purchasing research services, the government uses the threat of withholding payment as the means of enforcing laws unrelated to those services."[32]

The Soviet and Nazi experiences, although almost caricatures by American standards, still stand as models of what can happen when the government assumes central responsibility for funding higher education and basic research. They illustrate how the institution of science can be damaged and researchers persecuted, and how, in turn, the conduct of science, deprived of moral content, can be used as a tool of repression and brutality. Germany under Hitler tried to develop an "Aryan physics," excluding, by law, non-Aryan researchers and "political unreliables." German universities, under direct state control, were subject to this law, and "at least 25 percent of the physicists with German positions in 1932-33 were displaced during the Nazi period."[33] Included were 11 Nobel laureates. Future appointments were made on the basis of political suitability, not professional qualifications. The concept of "Aryan physics" included a demand for physics somehow based on "pure Aryan ideology," and excluded "Jewish ideas." (Relativity was a Jewish idea.) Klein notes that some physicists held out and continued to teach theoretical physics, but not usually as an expression of political opposition. They received some support -- from Goering and Goebbels -- because of the need of the war machine for real-world physics.

Soviet science, particularly during the Stalin era, was just as highly politicized; again science was linked, politically and philosophically, with state ideology -- in this case, with Marxism. This bogus enterprise was carried out through arbitrary political decisions by a political elite.[34] Upon his defection to the West, a chief Soviet science officer continued to defend his role in the politicization of Soviet science:

I believe that in the world in which we live today, where ideological, political struggle has not disappeared such controls are to a certain extent indispensable...Because if science escapes into objectivism this is no good for science itself.[35]

During the Stalin era, the discredited theories of Soviet geneticist Trofim Lysenko were installed as official government ideology. Soviet agriculture suffered severe setbacks as a result, when collective farms were not allowed to plant hybrid corn.[36] To the bureaucratic mind, Lysenkoism and arbitrary, capricious decisions are preferable to free, unfettered inquiry, to research conducted without bureaucratic oversight.

Soviet Russia and Nazi Germany are end-point results of total state control over the individuals and resources within a society; one would expect correspondingly total control over research and teaching to promote the goals of the total state. Of course, America is far from this extreme. The point is that this is what state control of science can look like. As more and more resources are concentrated in the hands of the government, science will become increasingly politicized. In America, research is indeed starting to suffer from the heavy hand of political decision-making: preferential political hiring, security checks, and censorship.

Reagan administration officials have, in fact, made no secret of their use of overtly political considerations in scientific appointments. One particularly striking example was provided by a former deputy assistant secretary of the U.S.

Department of Agriculture, John Schrote (now serving in the presidential appointments review office). Until recently USDA was making loyalty checks on its peer reviewers (for grant allocation). Schrote defended the policy of selecting peer reviewers who were "philosophically compatible" with President Reagan, people "who embrace the President's values and agendas."[37] The individual primarily responsible for screening nominees, Charles Grizzle, had this to say: "If two names are submitted to us and one is a Democrat and one is a Republican, we will choose the Republican." Grizzle then added that "there is no effort to politicize those panels." Suggestions to the contrary are being made by people who "must be trying to embarrass the secretary, and we're not too pleased about that."[38] He who pays the piper does indeed call the tune. Were this policy of science by loyalty oath to become the norm for all the other federal agencies, perhaps then we could witness an American conservative version of politicized science. One is led to wonder whether some of President Reagan's appointees would find favor with say, recombinant DNA research or evolutionary genetics or neurophysiology. Charges of politically motivated bias have appeared over the refusal of the government to provide research money to the National Academy of Sciences for research on acid rain, a politically volatile subject for the Reagan administration.[39] There will certainly be additional examples.

President Reagan's personal science advisor, George Keyworth, acts as the intermediary between the scientific community and the President, and helps formulate science policy. W.D. Carey, executive officer of the American Association for the Advancement of Science, describes the relationship: "If a science advisor is going to count, he must be a foot soldier marching to the program of the President, not the company chaplain."[40] Keyworth admires Reagan and states: "My philosophy is in complete consonance with the President's."[41] According to Keyworth, it is "eminently reasonable for the President to want scientific panels that share his political philosophy." And "ultimately we will choose a person [for National Science Foundation Director] whose philosophy is compatible with that of the President."[421

Politicization is not a problem unique to the Reagan administration (though it apparently is growing more serious than in previous administrations). Donald Fredrickson notes: "There is always someone who exerts more zeal than is justified in appointments....With each political era we find examples where the sensitivity of the scientific system is tested by abuses."[43] Thus, we find that during the Nixon administration, officials considered revoking federal research funds to the Massachusetts Institute of Technology as a political reprisal stemming from President Jerome Wiesner's opposition to the antiballistic missile program.[44] Reports also surfaced at that time that the Nixon administration was considering revoking federal grants in response to criticism of the Cambodia invasion.[451

Democrats have also been guilty. President Lyndon Johnson, angered by opposition to his Vietnam War policies from within the research community, is said to have searched through budget documents and personally scratched some research projects.[46] President Carter's Energy Research and Development Administration, during the furor over the energy crisis, did a study on future energy availability, known as MOPPS. The study developed a price/supply curve which showed that there was an abundance of pressurized methane gas reserves, contingent on the market price, making the notion of an energy crisis difficult to substantiate. The Department of Energy sent the study back to ERDA twice, seeking a more politically acceptable assessment. The third study again showed that natural gas supplies were kept unavailable by price controls. DOE didn't want to hear that, so they ordered the study removed from the shelves of Depository Libraries and destroyed.[47] The administration also fired Vincent McKelvey, director of the U.S. Geological Survey, and removed Dr. Christian Knudsen from his position as director of the MOPPS survey.

**National Security Issues**

As treasury funds available for research level off or decrease, allocation of scarce funds will be made to some extent on political grounds. As noted, the Reagan administration has favored defense R&D and has cut a few select programs. Reagan proposed to devote 61 percent of total research and development funds to military programs in FY 1983, up from 47 percent in FY 1980. Military R&D spending authorization will grow from about $17 billion in 1972 to $20 billion in 1983; of this, $712 million is budgeted for basic research. Total federal funds for basic research will amount to about $5.57 billion in FY 1983.[48] A substantial proportion of the nation's scientists and engineers are involved directly with military R&D. Estimates are that from 30 to 50 percent of the engineers and scientists in this country are engaged in military-related research.[49] Military spending -- whether for R&D procurement, or development -- adds little to the long-term economic well-being of our society and drains resources from the private sector. If economic resources are not productively utilized by the Department of Defense, then certainly scientific manpower is similarly

wasted.

The "spinoff" argument -- that military-related R&D produces significant incidental advances in civilian technology -- has been shown empirically to be invalid. Additionally, it makes no sense to argue that it is possible to direct resources into military R&D and expect that this would "routinely produce an efficient generation of knowledge pertaining to a completely different area" such as civilian economic activity.[50]

In practice, perhaps the best we can hope for is that the fruits of military R&D will not be used. Historically, expansion of domestic military expenditures and heightened national security concerns have tended to produce policy destructive of freedom of speech and of the press. Recent defense establishment initiatives have placed restrictions on publication and dissemination of unclassified research results. At the last minute, presentation of about 100 unclassified optical engineering papers was blocked at an international symposium.[51] At least some of the papers were sponsored by the U.S. government. The ban resulted from a growing administration concern over Soviet acquisition of Western technology. The scientific community has objected, but the root problem still needs to be identified. Thus, the American Association for the Advancement of Science issued a resolution which was accurate as far as it went:

Whereas freedom and national security are best preserved by adherence to the principles of openness that are a fundamental tenet of both American society and of the scientific process, be it resolved that the American Association for the Advancement of Science opposes governmental restrictions on the dissemination, exchange, or availability of unclassified knowledge.[52]

A report prepared by a panel of the National Academy of Sciences said that open communication or presentation of unclassified research results

has been of little consequence to U.S. security.... To attempt to restrict access to basic research would require casting a net of controls over wide areas of science that could be extremely damaging to overall scientific and economic advancement as well as to military progress.[53]

Open international communication and academic freedom in general is necessary for technological and economic growth in the U.S. Unfortunately, bureaucrats and military leaders look primarily to their own concerns, from a perspective which does not easily appreciate academic freedom. Admiral Bobby R. Inman, former deputy director of the C.I.A., has warned that scientists may face greater restrictions on communication of research results during the next decade.[54] The current partnership between science and government facilitates the government's ability to demand restrictions of this sort, and it is unrealistic to expect that such restrictions will diminish. Dire warnings from the academic community can do little more than slow the process.

**Alternative Funding**

If open scientific inquiry, academic freedom, and independence of universities from bureaucratic and political control are incompatible with government funding of research, are there realistic alternatives? Certainly great progress has been made during the three decades of substantial government involvement in research funding, but now the chickens are coming home to roost. If federal funding were to be phased out, would foundations, industry, and universities be able to fill the gap? A number of considerations are involved. Most obviously, it would help if more resources were simply left in the private sector. This would make more money available for private investment in research, not to mention giving a substantial boost to the economy. Reducing paperwork and bureaucratic intervention in both universities and industry would also free up resources.

Most likely, government's approach to research -- that more is always better -- has enlarged research activities beyond optimum levels. A view now widely held is that most first-rate research is done by a relatively small number of individuals working in a few distinguished institutions. A study in 1972 focusing on physics research in the U.S. found that the work of the large majority of researchers is of relatively little consequence and does little to advance scientific progress.

The data would seem to suggest that most research is rarely cited by the bulk of the physics community, and even more sparingly cited by the most eminent scientists who produce the most significant discoveries....Clearly most of the

published work...makes little impact on the development of science. Thus the basic question emerges, whether the same rate of advance in physics could be maintained if the number of active research physicists were to be sharply reduced....What we are suggesting is that science would probably not suffer from a reduction in the number of new recruits and an increase in the resources available to the resulting smaller numbers of scientists. Perhaps the most serious problem that science faces today in recruiting is the perceived reality that there are few jobs available to new Ph.D's. Reducing the size of science so that supply would be in better balance with demand might ultimately increase the attractiveness of science as a career.[55]

Universities have increasingly become the centers of basic research in the United States, performing 32 percent of all basic research in 1958, and 52 percent in 1978. In 1978 universities derived 72 percent of their basic funding from government.[56] Meanwhile, industry reduced the proportion of its own resources going to basic research in-house.[57]

Industrial innovation is generally considered to lag behind the demands of international competition. Most observers emphasize the role of government "disincentives" arising from federal regulations and tax policies, outmoded patent laws, and antitrust laws.[58]

Underinvestment in industry R&D arises in part from federal policies that limit available investment capital. Inflation, caused by government expansion of the money supply and high interest rates, influenced by government borrowing in the private money markets, limits available risk capital. Small businesses, traditionally an important source of innovation, are hit particularly hard by complex federal regulations and by tax incentives which favor large concerns over smaller ones. The present patent system has eroded protection, and patent application has grown complicated and expensive.[59]

Antitrust laws prevent corporations from combining resources for cooperative R&D, or even exchanging research results, and so inhibit innovation in areas calling for substantial capital investment.[60]

Federal regulations discourage innovation when the cost of compliance makes new products commercially not viable. Chemistry is an example -- marketing a new pharmaceutical or fuel additive is now very difficult and time-consuming, and so there is less industry demand for research in this area.[61]

Government provision of basic research reduces industry incentives to provide funding for its own research, and in a sense, provides a business subsidy at taxpayer expense. If more bright, young researchers were to be hired by industry, it could well result in much-needed innovations in industrial techniques.[62] On the other hand, continued government meddling may result in an American equivalent of the British "brain drain" of the 1960s, with top American researchers migrating to a more favorable research environment, perhaps Japan.

Can a healthy research effort in the United States be maintained in the absence of government funding? The long-term answer is clearly yes. In fact, decentralized alternative funding probably represents the only real possibility of a revitalized and independent research community. During the period of expansion of federal involvement in research, in the 1950s and 1960s, industry did not try to compete, and ended much of its existing support for graduate education in favor of NSF, NIH, and NASA programs.[63] Industry continues to have a clear interest in graduate education, and could be expected to resume funding in the absence of federal or state support.

Industry and academia are beginning to set up joint research projects. For instance, agreements have been forged for biological research between Harvard and DuPont ($6 million), between Washington University in St. Louis and Monsanto ($23.5 million), and between Hoechst (a West German firm) and Harvard-affiliated Massachusetts General Hospital (for $70 million).[64] Alternatives such as these should begin to be developed immediately, so that government funding can be painlessly severed. Scientists should recognize that availability of alternative private funding is adversely influenced by the transfer of wealth from the private sector to the public sector. Continued government dominance in funding basic scientific research is incompatible with an independent intellectual community.

**Conclusion**

Jacob Bronowski, in his great humanist examination of science and the human condition, recognized this profound dilemma:

There is an age-old conflict between intellectual leadership and civil authority. How old, how bitter, came home to me when I came up from Jericho on the road that Jesus took, and saw the first glimpse of Jerusalem on the skyline as he saw it going to his certain death. Death, because Jesus was then the intellectual and moral leader of his people, but he was facing an establishment in which religion was simply an arm of government. And that is a crisis of choice that leaders have faced over and over again: Socrates in Athens; Jonathan Swift in Ireland, torn between pity and ambition; Mahatma Gandhi in India; and Albert Einstein, when he refused the presidency of Israel.

I bring in the name of Einstein deliberately because he was a scientist, and the intellectual leadership of the twentieth century rests with scientists. And that poses a grave problem, because science is also a source of power that walks close to government and that the state wants to harness. But if science allows itself to go that way, the beliefs of the twentieth century will fall to pieces in cynicism. We shall be left without belief, because no beliefs can be built up in this century that are not based on science as the recognition of the uniqueness of man, and a pride in his gifts and works. It is not the business of science to inherit the earth, but to inherit the moral imagination; because without that man and beliefs and science will perish together.[65]

Intellectual endeavor and scientific research must be placed beyond the reach of state authority. Creativity and innovation can be encouraged through decentralization; but if intellectual endeavor in the United States continues to be controlled through centralized federal funding, we will one day witness the end of independent thought and political freedom.

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