70. R. W. Egan, P. H. Gale, G. C. Beveridge, G. B. Phillips, L. J. Marnett, *Prostaglandins* **16**, 861 (1978).
71. M. E. Hemler, G. Graff, W. E. M. Lands, *Biochem. Biophys. Res. Commun.* **85**, 1325 (1978); M. E. Hemler, H. W. Cook, W. E. M. Lands, *Arch. Biochem. Biophys.* **193**, 340 (1979).
72. R. W. Egan, P. H. Gale, G. C. Beveridge, L. J. Marnett, F. A. Kuehl, Jr., *Adv. Prostaglandin Thromboxane Res.* **6**, 153 (1980).
73. L. Flanders, P. Boroski, P. Palicharla, D. Fretland, *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **37**, 385 (1978).
74. J. A. Lindgren, H. E. Claesson, S. Hammerström, *Prostaglandins* **13**, 1093 (1977).
75. E. Ham *et al.*, *J. Biol. Chem.* **254**, 2191 (1979).
76. S. Moncada and J. R. Vane, in *Biochemical Aspects of Prostaglandins and Thromboxanes*, N. Kharasch and J. Fried, Eds. (Academic Press, New York, 1977), p. 155.
77. F. A. Kuehl, Jr., *et al.*, *Adv. Inflamm. Res.* **1**, 419 (1979).
78. J. J. Adcock, L. G. Garland, S. Moncada, J. A. Salmon, *Prostaglandins* **16**, 179 (1978).
79. R. B. Zurier, S. Hoffstein, G. Weissmann, *Arthritis Rheum.* **16**, 606 (1973).
80. P. Davies, R. J. Bonney, J. L. Humes, F. A. Kuehl, Jr., in *Macrophage Regulation of Immunity*, A. S. Rosenthal and E. R. Unanue, Eds. (Academic Press, New York, 1980), p. 347.
81. R. B. Zurier, G. Weissmann, S. Hoffstein, S. Kammerman and H. H. Tai, *J. Clin. Invest.* **53**, 297 (1974).

Science and the University

A. Bartlett Giamatti

Summary. The federal government-university relationship in scientific research has been eroded by excessive, unthinking regulations for the purposes of accountability. The Office of Management and Budget's Circular A-21 continues to jeopardize the quality of government-sponsored research in universities by demanding wasteful, meaningless work-load documentation. These regulatory demands must be revised to reflect the realistic obligations of accountability by a leadership capable of transcending special interests. Mutual respect between government and universities must be restored to achieve a partnership that helps better the national life while also protecting the integrity of the scientific faculty and its mission.

I have chosen to speak on the difficulties and challenges of doing basic research in science in a research university. Basic research is not, of course, confined to the activity of scientists. Basic research, that is, investigation that seeks new knowledge and understanding rather than solutions to immediate problems, is the essential nature of research on the part of all scholars. It obviously includes but is not restricted to basic research in the biological, medical, physical, and many social sciences. In the sciences, however, there is a particular style to the enterprise. Teaching in these areas, done in laboratories, in groups or teams, through colloquia, on field trips, with undergraduates and graduate and postdoctoral students, with assistants and associates in research, is intimately and inextricably connected to research. In science, teaching and research not only go hand in hand, they are often the same hand, the pedagogical act an act of investigation, the investigatory act shared with students and associates who are also colleagues, the whole a splendid instance of intellectual and human collaboration. Of course, scientists also work alone. Not all that is done is the result of a group effort. And not everything that is done occurs in a unified act that is both pedagogical and investigatory. But the distinctive style of scientific investigation is collaborative, and the distinctive process is such that is it impossible finally to distinguish research from teaching, seeking from sharing.

Federal Support of Basic Research

The dollars involved in supporting and furthering this kind of basic research are immense. They are largely federal dollars, which is to say taxpayers' dollars. In constant 1972 dollars, the government spent $2.8 billion on basic research in 1978, up $1.8 billion since 1960, when the reaction to Sputnik was in full flight. In 1958, 32 percent of all basic research in America was done in universities; by 1978, 52 percent was being done in universities. And in those universities, in 1978, 72 percent of the money for basic research came from the federal government. The result of this federal support to university-based science has been tremendous improvements in the life of America's citizens. In health care, in the production of food, in the handling of information—in the quality of our life—our government has brought about massive benefits by encouraging science and scientific research in universities.

The federal money that comes to universities brings with it money for the support of the administration of these complex projects; it brings reimbursements for "indirect costs." Indirect costs, or overhead, provide reimbursement for expenses which cannot be accurately assessed for each research project. They include, therefore, reimbursements for part of the cost of heating, cooling, and maintaining research laboratories, as well as part of the cost of essential supporting services (such as accounting and purchasing). Finally, these reimbursements bear part of the price of meeting federal requirements in certain areas (affirmative action, biosafety, the protection of human subjects). In 1960, Yale received some $24 million in federal funds, $3 million of which was indirect cost money; in 1980, Yale received $68 million in federal money, $21 million of which was in indirect costs. Thus about 30 percent of the total operating budget of the university—a great deal of money, but not a particularly high percentage compared to that at other universities—comes from the government.

It was not difficult for the government in the last 20 years partially to turn universities into installations for federally sponsored basic research in space, cancer, agriculture, energy, and a thousand other areas. Scientists were delighted to have their work supported and appreci-

The author is professor of English and Comparative Literature and president of Yale University, New Haven, Connecticut 06520. This article is based on his address to the Association of Yale Alumni on 16 October 1980.

0036-8075/80/1128-0984$00.75/0

ated; university administrators were delighted to have science expand and, with the additional moneys garnered, to have their institutions generally supported and made bigger. Everyone benefited. While the money was flowing, while there were ample pools of students, while energy was seemingly cheap, while facilities could be expanded or renovated, and while instrumentation and space could be acquired, all seemed well.

The welcome streams of federal money for research, however, opened the channels for a mounting wave of regulation, and there are now at least 59 federal laws and regulations that govern or affect scientific research in universities (*1*). Federal regulation is not, prima facie, evil. The obligation of the government to protect those citizens who cannot protect themselves, as in civil rights legislation, is unquestioned. The obligation of the government to account for money it collects from its citizens, and to require accurate accounting from those to whom the money is extended on behalf of the people, is unquestioned. I raise the issue of federal regulation not at all to object to regulation in principle, but to object to it as a set of processes; I do not object to the need for regulation in certain circumstances, or to the obligation to regulate, but rather to how regulation often works. I am proud of a government that promotes equity in human affairs and in matters of the marketplace. I am appalled, however, by the requirements for massive amounts of paperwork; by uncoordinated or special interest mandates that promote social goods with no awareness of the costs to other social goods; by an unwillingness or inability on the part of regulators to recognize legitimate and necessary distinctions among social entities being regulated. I believe in regulation but not in leveling all distinctions and issues. The City of God is desirable, but it does not occur when a landscape consists of evenly distributed rubble.

Because of excessive or unthinking regulation, the relationship between government and universities is seriously damaged. There is powerful resentment on all sides, and distrust. Goodwill is eroded dangerously, and a strain very old and very deep in our culture—a radical skepticism bordering on open contempt for our centers of learning with their strange, haughty ways—surfaces again. In general, federal agencies and universities find each other incomprehensible in structure, obdurate in attitude, intractable in negotiation. This recent and growing schism between government and universities is not created by science but it deeply affects the capacity to do science.

It is time for a concrete example. I choose the one summarized across this country in the scientific research community by the designation A-21.

Circular A-21

Two and a half years ago, when I first heard of it, I thought A-21 was a vitamin. I was wrong; A-21 refers to that circular from the Office of Management and Budget (OMB) entitled "Cost principles for educational institutions," published in its most recent form in the *Federal Register* on 6 March 1979. In it, the government proposes means to account for its money. It wishes to know if the money is used for the purpose for which it was given, and if direct and indirect moneys are properly accounted for. The principle of accountability, as I have said, is not at issue. What is at issue is *how* the accountability will be accomplished. The OMB says in A-21 that there must be "activity" or "total work load" documentation, and that faculty members on federal grants or contracts must report their work load or effort in multiple categories—research, teaching, service, administration (*2*). These discrete categories must be reported in terms of percentages, and these percentages must add up to 100 percent. Like many others, I object—on the grounds that:

- Some individuals in the government must believe that government fully owns a principal investigator and has a right to require documentation of that person's "work load" even when that work is unconnected with federally sponsored work.
- Some individuals in the government must misunderstand completely that it is impossible to segregate teaching from research from administration in doing basic research and to assign precise percentages to these false distinctions.
- Such requirements to create false categories will inevitably result in reports which are wholly meaningless and may only bury, not reveal, genuine instances of improper use of federal money.

These requirements, and objections, are not new. This circular, issued on 10 September 1958 by the Bureau of the Budget, was revised in the summer of 1967, when the bureau introduced new amendments to A-21 which would have required detailed segmenting and documentation of faculty effort. The intensity of the outcry against those regulations led to the formation of a task force, chaired by Cecil Goode, of the Bureau of the Budget, to examine the issue. After extensive interviews involving 22 universities and more than 350 individuals, mostly faculty, a report—"Time or effort reporting by colleges and universities in support of research grants and contracts"—was made public in February 1968. The first of its five recommendations began: "1. For professorial staff, drop the requirement for effort reports contained in the present [1967] Circular A-21." And the first two of its six conclusions read in toto:

> 1. Time or effort reports now required of faculty members are meaningless and a waste of time. They have engendered an emotional reaction in the academic community that will endanger university-federal relations if relief is not provided. They foster a cynical attitude toward the requirements of government and take valuable effort away from more important activities, not the least of which is the research involved.
>
> 2. We need to go to a system that does not require documentary support of faculty time devoted to government-sponsored research. No real evidence of faculty effort is provided anyway under the present system, and there is no way to prove how much effort was in fact expended.

Those sentiments are as valid in 1980 as they were in 1968. Was the task force co-opted or stacked? Was it subverted by "emotional" academic members? No. The bottom of the title page tells us it is "A report by a task force comprised of representatives from [the] Bureau of the Budget, General Accounting Office, Department of Defense, National Science Foundation, Department of Health, Education, and Welfare."

Relevant officials of the government advised against the proposed government regulations. As a result, circular A-21 was revised and the objectionable requirements on effort reporting were dropped. Did the government forget its own study? Yes. In 1976, the Department of Health, Education, and Welfare (DHEW) redrafted A-21 and in general reconstituted those features against which the government task force had so strongly advised.

Subsequent negotiations on the subject of work-load documentation between universities and OMB and DHEW accountants availed little. History was completely ignored, the most terrifying mistake of the mind an individual or a government can make. The OMB was also indifferent to recent events. A private and independent effort to satisfy the need for accountability and to salvage the decomposing relationship between government and the universities in the

area of sponsored basic research resulted in the creation of a National Commission on Research. Its membership included outstanding individuals from the American Association for the Advancement of Science, major private corporations, universities, research institutes, and foundations. In February 1980, the commission published the first of a projected series of reports: "Accountability: Restoring the quality of the partnership" (*3*). The title is admirably descriptive of the basic issues.

Among other recommendations, the National Commission on Research spoke directly to the issues of effort reporting [recommendations 4 and 5 (*3*, pp. 21–22)]. In these and other areas, it asserted the need for proper accountability and sets forth rational, tough, workable grounds for sharing the responsibility as well as the funds. Many urged these recommendations on the OMB. Nothing came of the urging. In October 1979, circular A-21 went into effect. Then early this fall, the OMB approved on an experimental basis a method of statistical sampling designed to provide accountability in a much less intrusive fashion for the scientists involved and to yield much more accurate and realistic information for the government agencies. I hope this method is designed to work. I hope that with regard to documentation of total work load the OMB does not remain forever enthralled by its own regulatory rhetoric. We will see. In the meantime, never have I seen the lash of federal regulation applied to a crucial area of the nation's intellectual life with such seeming indifference to financial and human consequences. In its issue of 3 October 1980, *Science* estimated that at Stanford University alone, these new regulations would require an increase from 3,000 to 80,000 reports annually, and $250,000 to $300,000 to put in place the new reporting system (*4*). It has been a long and deeply disheartening series of events, wasteful of energy and faith and time.

On so many other matters touching basic research, President Carter's Administration has demonstrated its awareness at the highest levels that basic scientific research carried out in universities is essential to the productivity and the long-term revitalization of many segments of the U.S. economy. Indeed, the most recent statement of this recognition of the mix of teaching and research in the furtherance of science was clearly made by Vice President Mondale in a speech at Massachusetts Institute of Technology on 25 September 1980. Below the highest levels, however, this spirit and vision have not prevailed. I hope the vision will prevail, because what is at stake is the quality of American science and, therefore, of a free, stable, productive nation.

Reasonable Solutions

What is needed? Aside from the issues involved in A-21 or any other specific set of regulations, we continue to need leadership capable of transcending special interests and seeing—whole—the public interest. Whether in the areas of basic research or of financing higher education, whether around regulations concerning safety or athletics or informed consent or waste disposal, there must be no lessening of the moral imperatives or of necessary accountability. But there must be at all levels of government, and the university, some renewed mutual respect, some common conviction that it is in the nation's interest that government and centers of learning collaborate, and that the purpose of collaboration is the betterment of the nation's life. There must be some disposition to identify the larger issues and find reasonable solutions within a general perspective that recognizes institutional differences and common goals. Too much is at stake for all of us.

What will Yale do? We will continue to press for open discussion and for the responsibilities of the university, its responsibility to be accountable, its responsibility to protect the integrity of its faculty and the independence of its mission. We will volunteer to be part of the experiment of statistical sampling meant to show that there is a simpler yet sound approach to accountability. We will continue to work for collaboration. That is, after all, our very essence.

In restoring a partnership with the government we will call on alumni to help make our case. As citizens of the country, as members of the Yale family, these are their problems as they are mine. They can help in this task, and I will ask for help. We must also increasingly rely on faculty for assistance. Through no fault of theirs, members of the faculty have far too seldom been asked by universities to participate in the policy-oriented conversations with the government on matters which profoundly affect their ability to do research and to share their knowledge and discoveries with others. Not only is faculty often expert in the areas I have identified, but there is a deeper, more searing problem to be addressed. Unintentionally, the government and its regulations have set faculties against administrations. Had the government wished to split universities internally, it could not have found a better way than to make administrators custodians of regulations they do not necessarily accept, and make faculty the bearers of the burden of frustrated resistance. The collegiality of our institutions of learning is our driving ideal, a unique asset; it cannot be imperiled. There are pressures enough on universities without allowing federal regulations to sunder us.

And we will continue to encourage appropriate links between the private corporate sector and the university, in order to find alternative sources of money, and to seek new sources of intellectual stimulation for university scientists. Collaboration is not a concept to be confined to the relationship with the federal government. Such collaboration will be far from easy. There is still, despite all the new talk of such relationships, a ballet of distrust and defensiveness between universities and the corporate world. And there are genuine risks. The dangers we have seen in the various forms of federal intrusion cannot be exchanged for other kinds of intrusion from the private corporate sector. Neither is allowable. One is not preferable to the other. The norms of university research remain and must remain those of free access to information, independent assessment of evidence, the capacity freely to publish results subject to review of peers. To those who fear that the private sector will impose requirements on the university which would violate the academic integrity and processes that lie at the heart of our place, I say I understand the concern and will not ever dismiss it. No money offered from any quarter that would require inappropriate promises or behavior will be accepted.

My experience is that the private sector tends to understand and respect the norms and values of a private university far better than the federal government. Private corporations have, after all, their own private corporate norms too; conversations between them and universities quickly establish the lines each entity must respect and protect. Private corporations do not have the capacity to follow their money with coercive regulations unconnected with anything else. They do not forget from administration to administration, or from department to department, what they have said.

Understanding all this, however, I do not propose to see the values and integrity of the university compromised. I do

intend to explore relationships, with any part of our society with whom we can appropriately and honorably collaborate, and I intend to explore such relationships in possession of our principles, mindful of the history of our federal relations, sensitive always to the fact that the university is an independent institution in our society and that it cannot serve society responsibly unless that independence is its paramount concern.

The problems I have discussed are not glamorous and brightly colored; their solutions are not simple or to be magically derived from a single source. They are gritty, grainy problems that involve hundreds of hours of work, thousands of details, millions of words, endless pieces of paper. They are deeply important problems, however, not because of the details or even the dollars but because they speak to how science is done. They speak to what the future holds for America's capacity to improve its productivity and economic vitality and to improve the quality of its citizens' lives through science and technology. The issues of collaboration, regulation, and independent integrity also pierce to the center of the whole process of apprehending and comprehending the world we live in, the worlds we are; that is the essence of science as it is of everything else we do in the university.

Science is at the core of the university's mission to foster the disciplined imagination. Whatever strikes at that core, cuts at the heart of the university. For all these reasons, those that tell us what we must assert and that tell us what we must protect, our topic here could not be more worthy of our attention.

References and Notes

1. P. H. Abelson, "Diversion of funds from research," *Science* **208**, 353 (1980).
2. "Each report will account for 100 percent of the activity for which the employee is compensated and which is required in fulfillment of the employee's obligations to the institution. The report will reasonably reflect the percentage of activity applicable to each sponsored agreement, each indirect cost category, and each major function of the institution" (paragraph J.6 in circular A-21).
3. "Accountability: Restoring the quality of the partnership" (National Commission on Research, Washington, D.C., 1980).
4. J. Walsh, *Science* **210**, 34 (1980).

AAAS–Newcomb Cleveland Prize
To Be Awarded for an Article or a Report Published in *Science*

The AAAS-Newcomb Cleveland Prize is awarded annually to the author of an outstanding paper published in *Science* from August through July. This competition year starts with the 1 August 1980 issue of *Science* and ends with that of 31 July 1981. The value of the prize is $5000; the winner also receives a bronze medal.

Reports and Articles that include original research data, theories, or syntheses and are fundamental contributions to basic knowledge or technical achievements of far-reaching consequence are eligible for consideration for the prize. The paper must be a first-time publication of the author's own work. Reference to pertinent earlier work by the author may be included to give perspective.

Throughout the year, readers are invited to nominate papers appearing in the Reports or Articles sections. Nominations must by typed, and the following information provided: the title of the paper, issue in which it was published, author's name, and a brief statement of justification for nomination. Nominations should be submitted to AAAS-Newcomb Cleveland Prize, AAAS, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Final selection will rest with a panel of distinguished scientists appointed by the Board of Directors.

The award will be presented at a session of the annual meeting. In cases of multiple authorship, the prize will be divided equally between or among the authors.

Deadline for nominations: postmarked 15 August 1981

Nomination Form
AAAS–Newcomb Cleveland Prize

AUTHOR: _____

TITLE: _____

_____

DATE PUBLISHED: _____

JUSTIFICATION: _____

_____

_____

_____

_____

_____

_____

_____