PUBLIC SCIENCE

Francis Slakey
Office of Public Affairs
American Physical Society

Our nation's federally funded scientific enterprise is in a privileged position: to a large extent it is self-policing, self-judging, and self-regulating. For nearly fifty years, the government has taken a hands-off approach to managing science, believing that the best science will be carried out if researchers are allowed to determine the direction of science without political constraints. Consequently, scientific excellence, as judged by peer review, has been the primary criterion for determining which projects the government would fund.

Times have changed. Representative George Brown, the Chair of the House Science, Space and Technology Committee--the committee responsible for authorizing the missions for all the science agencies in the federal government--has had enough:

> There is a dark side to our progress. The market-driven technological approach to science provides solutions that actually exacerbate societal inequity. The ability of human beings to achieve a basic measure of human dignity does not depend on advanced technology. Is our path into the future to be defined by the literally mindless process of technological evolution and economic expansion?[1]

> Society needs to negotiate a new contract with the scientific community. This contract must be rooted in the pursuit of explicit, long-term social goals such as zero population growth, reduced generation of waste, reduced consumption of non-renewable resources, less armed conflict, less dependence on material goods as a gauge of wealth or success, and greater opportunity of self-realization for all human beings. We've paid for forty five years of discovery, let's start requiring its application to the critical problems in the civilian sector.[2]

George Brown is questioning what has been taken for granted during the last forty five years of federally funded scientific research--that scientific progress, as determined by scientists, engenders human progress. America spent over a half trillion dollars on research and development during the last decade, and there are good reasons to question the general societal benefit of the results.

In the Pacific Northwest, scientific recommendations concerning sustainable development of fisheries have led to elimination of entire species of fish and near collapse of fishing industries.[3] In the Pantex nuclear weapons plant in Amarillo, Texas, lethal plutonium pits from dismantled nuclear weapons stack in the thousands while weapons scientists at Lawrence Livermore lobby the government to end the nuclear testing moratorium.[4] And throughout the world, access to advanced health care technology is limited by economic status-millions of people continue to die from famine and curable diseases.

From health care technology to weapons research, the inquiry has always been considered "good science." However, many of the results are now being recognized as inequitable or even deleterious. In general, scientists have been more concerned with pursuing "good science" than pursuing solutions to societal crisis in our education system, global environment, or inner cities. "Good science" may not be the "right science."

While scientists can straightforwardly undertake good science, it is not always clear how to analytically research the right science. Societal issues like health care, national defense, or the environment often have a critical human dimension that evades scientific analysis.

Calculations of effective management of natural resources cannot address political pressure and greed. Scientific research and development of an antiballistic-missile defense can't address the value of a Nuclear Non-Proliferation Treaty or Comprehensive Test Ban. In brief, technical problems are not necessarily solved with more technology--but technology is what science provides.

George Brown isn't the only science legislator in Congress concerned about these issues. Senator Barbara Mikulski, Chair of the Senate Appropriations Subcommittee for Veterans Affairs, Housing and Urban Development, and Independent Agencies--the subcommittee which determines the funding levels for the National Science Foundation--is also questioning the direction of our nation's scientific enterprise. However, unlike Brown, she sees no dark side to technology but instead believes that, if properly directed, science can revitalize our nation's economy. For evidence, her subcommittee interprets the past.

Science has produced technologies that led to the formation of billion-dollar industries and provided premier training for the US high-tech workforce. From the optical communications and semiconductor electronics industries, to medical technologies and biotechnologies, the scientists have delivered.

Appropriators believe that recent events have made scientists critical to our nation's economic prospects. In December of 1992, IBM announced that it will decrease research and development expenditures by over $500 million. Nationwide, 48% of the US industrial labs expect to freeze research funding and 28% expect to decrease research funding in 1993. By contrast, Japan's Ministry of International Trade and Industry is increasing investment in basic research and NEC Inc. of Japan opened a basic research lab annually budgeted at $22 million--in Princeton, N.J.

In the Senate Bill outlining the National Science Foundation FY '93 budget, the appropriators directed the following:

> While recognizing the role the Foundation has played in establishing US leadership in basic research over the past forty years, the committee believes that the Foundation should take a more activist role in transferring the results of basic research from the academic community into the market place. The committee believes that the Foundation should play the key role in making the Nation's academic research infrastructure more accessible to those endeavoring to build America's technology base and improve US economic competitiveness.[5]

Scientific excellence, as judged by peer review, has been the primary criterion determining the direction of our nation's research enterprise. But clearly this has not produced the global social benefit that the authorizing committee wants, or the local economic benefit the appropriating committee wants. Why, after forty-five years of federally funding science, are they suddenly so concerned? For the first time in the history of the federal support of science, there is no cold-war and no clear rationale for the large defense research- and development-expenditure. The conversion of the defense industry into a civilian economy requires a redirection of over $45 billion in annual federal research and development dollars. The appropriators and authorizers in Congress are just trying to figure what to do with the money.

In the past, the government assumed science was doing the right research, because a large percentage of scientists were developing what the government took to be necessary defense products. Now, the good and the right aren't so clearly defined. Perhaps they never were. In either case, the public, the scientists and the legislators need to stop and think about what constitutes "good" and "right" scientific research.

What clearly emerges from the quotations by Mikulski and Brown is that federally funded scientists have an obligation to address public needs. Our nation's scientific research enterprise should be addressing societal goals which are explicitly and implicitly set by

Congress and the Executive Branch and which presumably reflect the desires of the populace as filtered through elections and the press. The scientific establishment should not determine the direction of science based solely on the criterion that the research presents an exciting scientific challenge. Science must make judgments based upon what the public needs, wants, or deserves.

As a first cut, then, the moral duty of scientists might take the following form: **A federally funded scientist has the obligation to ensure that the taxpayers' dollars are directed towards projects promising the greatest societal benefit.** This obligation simply recognizes a scientist's responsibilities as a recipient of public funds--the direction of science must be determined relative to other social programs.

This is a straightforward utilitarian duty: our nation should fund programs that can be reasonably expected to lead to the best consequences overall. But just how hard would this be for scientists? Consider the following scenario. Five desperately ill patients all require immediate transplants of various organs. Fortuitously, a single person could provide all the organs necessary to the survival of the five. As luck would have it someone in for a routine checkup is a sworn utilitarian. He sacrifices his life and a surgeon saves the five.

If promoting the good is the most important endeavor bar none, the utilitarian must inevitably be an earnest altruist. The rigorous demands of utilitarianism are apparent to its leading sympathizer, Shelly Kagan:

> Consider just how radically demanding [Utilitarianism] is. It bids us to act not with an eye to merely furthering our own projects and interests, or those of some individual we may favor--but with regard for the interests of all individuals. It demands that I ask how I can make my greatest possible contribution--even though this may impose considerable hardship on me--and it forbids me to do anything less.
> To live in accordance with such demands would drastically alter my life. In a sense, neither my time, nor my goods, nor my plans would be my own. The claim is deeply counter-intuitive. But it is true.[6]

The five patients scenario is very similar to the circumstances faced by scientists funded by the National Science Foundation. Within their federal appropriations category are the following five "patients": welfare mothers, hurricane victims, victims of toxic chemical spills, disabled veterans, and the homeless. The federal appropriations process is zero-sum accounting--if a physicist gets a dollar more, one of these other five gets a dollar less.

[See figure at the end of this paper]

Since the utilitarian obligation, as currently stated, requires scientists to ensure that the taxpayers' dollars are directed towards programs promising the greatest societal benefit, scientists have to explain why they deserve the dollar. This puts scientists into the position of having to prove that their research is more critical to society than, say, housing for a welfare mother, health care for a disabled veteran, or support for a victim of the Mississippi River flood. Scientists have not been shy about making their case--sometimes to an embarrassing extreme. In some cases, they make an overstated pitch to their local Congressman, who in turn distorts the claim when fueling dramatic Congressional debate. Or, sometimes scientists just circulate propaganda directly to the press. The following are two notable examples:

> The value of the unpredictable spinoffs from space exploration are immeasurable. Among these are the heart monitor, pollution control devices, athletic shoes, smoke detectors, sunglass lenses, sewage treatment, and magnetic resonance imaging.[7]

> Richard Evans: My father and grandfather were steel workers, and I knew as I grew up in Baltimore that I would be a steel worker too. Sure enough, in the summer of began what I thought would be a career in the Bethlehem Steel Mills. By 1983, pressure from foreign competition hit the once mighty steel industry hard. I was lucky. I found another job. My son is now 17 and interested in mechanics. I hope that America makes more investments like the Super Collider because I don't want my son to repeat my experience. If we don't invest in technology for tomorrow, we will lose industries and jobs to countries that do.[8]

The technological spinoff claims are false. Investing in big science will not secure jobs in the high-tech industries because very few high-tech industries are even involved in these projects. And the propaganda concerning the life struggles of Richard Evans in surviving the collapse of America's steel industry is easily countered in Congressional debate with a far more dramatic appeal:

> It is very interesting to see the lobbying efforts on this. I listened with interest as our colleagues talked about children playing with cardboard boxes, dreaming that they were in spaceships. I remember those days too; however my thoughts today are with children of this Nation for whom cardboard boxes are not toys, they are beds and in some cases they are housing. These children dream not of space ships but of hot meals. That is what it is really important, the 500,000 homeless children in America who need assistance. The children of America cannot wait. The heavens can wait.[9]

From the largest scientific projects like the $35 billion Space Station or $11 billion Super Collider to $50,000 projects studying root rot, lobbyists are being called in to justify the expense. This is no way to address societal benefits. But this is precisely what pitting science against social programs in political debate encourages--lobbying on behalf of scientific proposals.

The obligation of scientists to assure the greatest benefit brings about the wrong ends for a simple reason: the obligation is overly demanding. Requiring an incoming patient to donate organs to five needy patients is clearly over-demanding, and so is requiring scientists to sacrifice their research project for the sake of the needy five in their federal appropriations category. Is there an option to the moral obligation that can relax the demand of self-sacrifice?

The utilitarian establishes a hierarchy of good and bad, and acts in a way that will maximize the likelihood that the good will occur--the utilitarian equates the good with the right. The deontologist maintains that it may be wrong to do what will produce the objectively best consequences; what is good is not always right. The deontologist maintains restrictions and options that delineate the good and the right, and the right is given primacy. These options give far more latitude to the deontological moral evaluation. They relax the demands on working for the "greatest good" and allow for a pursuit of "personal good."

Consider the scenario of the five patients and the donor:

> The utilitarian donor sacrifices his life for the five. In contrast, the deontological donor is not required to sacrifice his life for the five--he has an option. The deontological option allows for personal choice; there are actions which are permitted but not required. But how can the "personal" factor be morally justified?

In brief, if personal partiality is to have a moral foundation, it must be shown to be integral to human nature. Bernard Williams identifies a link between partiality and integrity:

> To require that [a man regard as one satisfaction among others a project or attitude round which he has built his life, just because someone else's projects have so structured the causal chain that is how the utilitarian sum comes out] is to alienate him from his actions and the source of his actions in his own convictions. But this is to neglect the extent to which his actions and his decisions... flow from the projects and attitudes with which he is most closely identified. It is thus in the most literal sense, an attack on his integrity.[10]

To disallow personal partiality is to hold the agent hostage to the enterprises of others. Without personal partiality an individual has no opportunity to structure his actions in accord with his values and develop a coherent relationship between his own motivations and his own projects and plans.

The development of one's own projects and plans is central to the identity of the individual--it defines the identity. As Samuel Scheffler explains:

> Each person has a point of view, a perspective from which projects are undertaken, plans are developed, and life is lived. Different persons, each one with his own projects and plans, are distinct, though to say this is obviously not to deny the reality or importance of empathy, identification, sharing, co-operation, joint activity and other related aspects of human experience. Indeed, as a moment's thought will show, these phenomena all presuppose the distinctness of persons.[11]

> To have an independent point of view is part of the nature of a person if anything is....For by incorporating a plausible prerogative which allows agents to devote energy and attention to their projects and commitments out of proportion to the weight from the impersonal standpoint of their doing so, [deontological] theories recognize and mirror the independence of the personal point of view.[12]

To the deontologist, an agent's projects and plans have a compelling claim on his action precisely because they are his projects and plans. They define his point of view; they define his very nature. Similarly, scientists must be allowed to develop an independent identity based on a set of general rationales and goals for science. If it means anything to be a practitioner of science, it means that one is a scientist and not a social worker. In funding science, the taxpayer and legislator must allow the practitioners of science to pursue science, not the general welfare. Consequently, scientists and legislators must determine which science to fund and how much science to fund apart from considerations of the veterans, homeless, or flood victims.

So, the original obligation can be modified to include an option: **A federally funded scientist has the obligation to ensure that taxpayers receive fair compensation for their investment in science.** Scientists can choose to sacrifice their research for the sake of Mississippi River flood victims--requesting that the National Science Foundation budget be reduced and the money be transferred into the Federal Emergency Management Agency--but they are not required to make the sacrifice.

This increases the importance of "the good of science" in determining the direction of scientific research and diminishes the importance of "the greatest good" that is primary in the purely utilitarian obligation. But is this new obligation overly permissive? According to this version of the obligation, scientists do not have to make their personal research contribute to society. All individual researchers would have to do is make sure that, in general, science is contributing to society.

But federally supported individual scientific research should not become purely

self-indulgent. The research undertaken by an individual scientist must still address the right of the public to receive fair compensation for their science investment. There is a clear understanding between the government and the citizens that the tax dollars are an investment in goods and services that are intended to promote the well being of the country. To prevent federally funded research from slipping into purely self-indulgent pursuits that have no bearing on the well being of the country, individual scientists must be required to personally address the rationales and societal goals of science.

So, in addition to the deontological option, a deontological restriction must be placed on the obligation of scientists. How is a moral restriction placed on the moral option of personal partiality? In general, an obligation must balance an agent's option for personal partiality with tolerance for the rights of other parties. The restriction on an agent's action is simply a recognition of the entitlements of all potential agents. In the case of the federally funded scientist, an individual investigator must balance his option for pursuing research he finds personally interesting with a recognition of the right of the taxpayer to receive compensation. Scientists must consider how their personal research fits into the general rationales for the support of science.

What we are left with is the following obligation: **A federally funded scientist has the obligation to ensure that his or her personal scientific research addresses societal goals for science.**

Representative George Brown and Senator Barbara Mikulski drew up a short list of societal goals for science: improving technological competitiveness, improving human health, researching global climate change, reducing the generation of waste, reducing consumption of non-renewable energy sources, less armed conflict, less dependence on material goods as a gauge of wealth or success, and greater opportunity of self-realization for all human beings.

While armed conflict is a technical issue, reducing armed conflict may be not be. While global climate change is a technical issue, reducing the ozone levels may not be. While extending life expectancy is a technical issue, equitable distribution of advanced health care may not be. Technology may not provide solutions to the societal problems Congress is currently expecting science to solve. Scientists must work with legislators to establish a realistic set of societal goals for science. If scientists are held to the current list, they will never be able to fulfill their obligation and the public will never be satisfied with scientific research.

Notes

1. George E. Brown, Technology's Dark Side, *Chronicle for Higher Education*, June 30, 1993, p. B1

2. George E. Brown, It's Down to the Last Blank Check, *Los Angeles Times*, September 8, 1992, Commentary.

3. Donald Ludwig, Ray Hilborn, Carl Walters, Uncertainty, Resource Exploitation, and Conservation: Lessons from History-, *Science*, vol. 260, p.17.

4. Earl Lane, Element of Danger, *Newsday*, 3/28/93, p. 7.

5. Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1993, Report 102_356, p. 157.

6. Shelly Kagan, *The Limits of Morality*- Oxford, Clarendon Press 1989.

7. Representative Jim Bacchus, *Congressional Record*, 6/23/93, H3990.

8. Lewis Tucker, For Whom Does it Matter?, Office of External Affairs, Superconducting Super Collider Laboratory, 1993.

9. Representative Nancy Pelosi, *Congressional Record*, 6/28/93, H4148.

10. J.J.C. Smart and Bernard Williams, *Utilitarianism For and Against* [Cambridge University Press 1973] pp. 116-117.

11. Samuel Scheffler, *The Rejection of Consequentialism, a Philosophical Investigation of the Considerations Underlying Rival Moral Conceptions* [Oxford, Clarendon Press 1982] p. 77.

12. Ibid, p. 58.

DISCUSSION

How effective is it to support only research focused on a specific application or goal? Often that will lead to the most prompt solution to the particular problem under investigation, but if pure research is neglected, would society miss discoveries that otherwise would not have been made? Part of the strategy of the Department of Defense has been to fund a significant amount of basic research under the assumption that a useful body of knowledge will be developed, from which future applications may arise.

On the other hand, there is no doubt that the federal government is trying to deal with significant budgetary pressures. Is funding research for its own sake a luxury this country can no longer afford? Some argue that such funding is not a luxury but rather a necessary component to the economic well-being of the country: cutting edge technology is maintained only through cutting edge basic research. However, the connection between pure research and technological advancements is often at best indirect, and hence a cause and effect relationship is difficult to establish.

Have scientists oversold the value of pure research? Are the arguments made in favor of it merely self-serving? Clearly many scientists benefit from federal sponsorship of pure research, calling into question their objectivity when putting forth arguments in favor of such funding. However, it is unreasonable to preclude scientists from stating their case; rather, the obligation lies in the accuracy of the information they provide in stating their case.

If only mission-oriented research is being funded, does that force scientists to lie or exaggerate if they want funding for pure research? If a scientist truly believes in the value of pure research, is it ethical to exaggerate the possible applications of a particular line of inquiry in order to secure funding? This dilemma represents a conflict between principles of honesty and beneficence.

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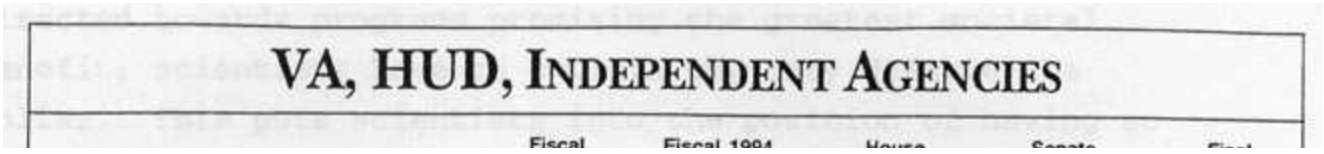

	Fiscal 1993	Fiscal 1994 Clinton Request	House Bill	Senate Bill	Final Bill
		(In thousands of dollars)			
Veterans Affairs					
Compensation and pensions	$ 16,969,239	$ 16,828,446	$ 16,828,446	$ 16,828,446	$ 16,828,446
Readjustment benefits	814,010	947,400	947,400	947,400	947,400
Insurance and indemnities	22,730	15,370	15,370	15,370	15,370
Loan funds	681,243	620,792	620,792	620,792	620,792
Health-care reform contingency fund	—	—	—	500,000	—
Medical care	14,645,723	15,642,452	15,522,452	15,637,452	15,622,452
Medical research	232,000	206,000	252,000	252,000	252,000
Construction projects	688,620	563,508	524,008	570,215	570,215
Other	998,336	1,004,662	1,004,578	1,024,578	1,008,078
TOTAL, VA	**$ 35,051,901**	**$ 35,828,630**	**$ 35,715,046**	**$ 36,396,253**	**$ 35,864,753**
Housing and Urban Development					
HOPE grants	271,000 [1]	109,190	119,190 [1]	109,190 [1]	109,190 [1]
HOME program	1,172,500	1,600,000	1,325,000	1,275,000	1,275,000
Assisted housing	8,861,665	8,423,000	9,192,900	9,334,900	9,312,900
Expiring Section 8 subsidies	6,796,135	6,358,106	6,358,106	4,558,106	5,358,106
Low-income housing projects	2,282,436	2,520,808	2,620,808	2,620,808	2,620,808
Severely distressed public housing	300,000	483,240	483,240	803,240	778,240
Drug elimination grants	175,000	—	265,000	265,000	265,000
Federal Housing Administration	262,149	231,990	231,990	231,990	231,990
Limitation on guaranteed loans	*(100,000,000)*	*(64,564,645)*	*(64,564,645)*	*(64,564,645)*	*(64,564,645)*
Ginnie Mae (receipts)	−322,500	−269,300	−269,300	−269,300	−269,300
Limitation on guaranteed loans	*(107,700,000)*	*(85,000,000)*	*(85,000,000)*	*(130,000,000)*	*(130,000,000)*
Homeless assistance	571,550	752,900	702,900	728,747	722,747
Community development grants	4,240,000	4,223,675	4,273,675	4,400,000	4,400,000
Other HUD accounts	195,885	833,220	603,767	528,619	534,000
TOTAL, HUD	**$ 24,805,820**	**$ 25,266,829**	**$ 25,657,276**	**$ 24,336,300**	**$ 25,208,681**
NASA					
Research and development	7,080,000	7,690,400	7,475,400	7,544,400	7,529,300
Space station	(2,122,500)	(1,946,000)	(2,100,000)	(1,946,000)	(1,946,000)
Space flight	5,058,800	5,333,800	4,878,400	4,892,900	4,853,500
Administration	1,635,014	1,675,000	1,637,500	1,635,508	1,635,508
Construction of facilities, other	535,062	565,800	528,091	555,691	565,691
TOTAL, NASA	**$ 14,308,876**	**$ 15,265,000**	**$ 14,519,391**	**$ 14,628,499**	**$ 14,551,399**
Environmental Protection Agency					
Research and development	323,000	353,565	353,565	328,565	338,701
Abatement, control and compliance	1,337,215	1,367,535	1,367,535	1,352,535	1,352,535
Superfund	1,573,528	1,496,400	1,416,100	1,496,400	1,480,853
Water infrastructure	2,550,000	1,528,000	2,477,000	2,500,000	2,477,000
Program, research, other	1,139,631	1,617,982	1,018,383	994,213	1,009,838
TOTAL, EPA	**$ 6,923,374**	**$ 6,363,482**	**$ 6,632,583**	**$ 6,671,713**	**$ 6,658,927**
Other Independent Agencies					
FEMA	2,827,270	796,846	792,119	1,190,329	788,289
Disaster relief	(2,292,000)	(292,000)	(292,000)	(292,000)	(292,000)
Disaster relief contingency fund	—	—	—	(400,000)	—
Limitation on direct loans	*(40,000)*	*(25,000)*	*(25,000)*	*(25,000)*	*(25,000)*
Planning and assistance	(253,243)	(222,960)	(212,960)	(215,000)	(212,960)
Food and shelter program	(129,000)	(123,000)	(130,000)	(130,000)	(130,000)
National Science Foundation	2,733,548	3,180,200	3,021,297	2,981,997	3,027,797
Research, facilities	(1,909,000)	(2,259,800)	(2,100,000)	(2,065,000)	(2,108,500)
Education	(487,500)	(556,100)	(569,600)	(569,600)	(569,600)
Selective Service System	28,616	29,012	5,000	25,000	25,000
National Service program	—	394,000	—	370,000	370,000
Other independent agencies	217,018	778,542	236,363	125,856	128,112
FSLIC resolution, RTC	2,661,510	1,365,842	1,367,046	1,205,582	1,212,314
GRAND TOTAL	**$ 89,557,933**	**$ 89,268,383**	**$ 87,946,121**	**$ 87,931,529**	**$ 87,835,272**

[1] *The bill would rescind $250 million of fiscal 1992 and fiscal 1993 funds for the HOPE program.*

SOURCE: House Appropriations Committee