agenda. The opportunities for changes in development assistance and environmental regulation pose great challenges—and offer great benefits—to the developed world, which badly needs leadership in these combined areas.

The United States did play a strong leadership role in preparing for the 1972 conference. It worked closely with the U.N. Secretariat to help structure the agenda, achieved interagency agreement on U.S. positions well in advance of the conference, and sent delegations of environmental officials to other countries to sensitize them to the issues to be raised in Stockholm, alert them to the U.S. position, and urge them to prepare their national reports. The Secretary of State appointed a distinguished outside advisory committee for the conference. Adhering to similar procedures would help to ensure that U.S. positions in 1992 will also be consistent, both internally and with respect to wider international interests, and well represented before and during the conference. This time, of course, U.S. participation should be broader, comprising high-level representatives of agencies with economic, environmental, and developmental responsibilities.

The problems to be discussed within the UNCED context are far more complex than those addressed in Stockholm in 1972. The coupled issues of development and environment are certain to bring forward a diversity of views. North-South conflict could doom the outcome of UNCED, as it has previous conferences, so that the meeting degenerates into bickering and accusations. But because UNCED offers opportunities for so many potential benefits—to all nations—it demands support at the highest levels of government everywhere, including that of the United States.

ROLAND W.SCHMITT

Fulfilling the Promise of Academic Research

The science community must better demonstrate that its work is instrumental to the nation's goals.

In *Science: The End of the Frontier?,* a report published by the American Association for the Advancement of Science (AAAS) this past January, it was said that American science and technology will do the following important things for our country: provide the basis for new industry, improve the health of the population, elucidate ecological and environmental issues, develop alternative energy sources and substitutes for scarce materials, and enhance our culture.

These are good, pragmatic reasons for strongly supporting science and technology in general and academic research in particular. But the challenge to the science community is to "fill in the blanks."

We have to persuade our political and industrial supporters that academic research contributes to practical applications and to the education of students in sufficient measure to warrant the level of support we seek—particularly now, when "adjusting to finite resources" is fast becoming society's watchword.

There is no single magic bullet or master plan that can achieve this objective, Rather, there are many specific actions that need to be

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strengthened or initiated. They fall into several groups:

- Improving our advocacy in the federal, state, and industrial arenas.
- Making better use of our resources.
- Improving the linkage and synergy of research and education.
- Devising innovative new initiatives to attract new resources.

Advocacy. In supporting science and technology, our political and economic systems are strongly biased toward the competitiveness of U.S. industry, regional economic development, education and human resources, and governmental functions such as health, defense, and environmental protection. In reality, there is little that we do in academic research that isn't relevant to these interests. But we must get better at dramatizing the linkages and aiming the arguments more precisely.

We tend to assume that our own enthusiasm for what we do is shared by the public. But by and large it isn't. Too many people share the view of the former Dutch queen, Julianna, who once ex-claimed, "I don't understand computers; why, I don't even understand the people who understand computers."

Nevertheless, we sometimes get generous support because what we ask for is politically attractive. For example, henceforth the superconducting supercollider is going to stand or fall not because of its potential contributions to our understanding of the first picosecond of the Big Bang, but because of the political clout of the Texas congressional delegation and its allies.

Thus we need to become more focused and sophisticated in how we pursue federal funding. We need to target particular appropriations subcommittees with particular messages on why our enterprise should compete favorably with other, often more understandable, priorities. Concurrently, we might also push for congressional reorganization of the appropriations subcommittees so that nearly all civilian R&D and related programs be considered by a single appropriations subcommittee. Prosaic-sounding stuff compared to the battle cry of "Another $10 billion," but likely to be more feasible and more important in the long run.

Elsewhere in Washington, the academic community has to argue more forcefully for basic and exploratory research funding in the Department of Defense (DOD), for competitive grants in the Department of Agriculture, for basic energy sciences in the Department of Energy, for the scientifically oriented programs in NASA, and so on. And each of these arguments has to be carried to particular agencies and particular congressional committees by informed people—preferably constituents—who appreciate the public interest. We should also face up to the issue of priorities, despite the present fragmentation of Congress. First, we must take seriously the priorities on critical technologies spelled out by DOD, the Department of Commerce, the Council on Competitiveness, and others. If we disagree with them, we should argue; but, if not, we should respond with well-reasoned proposals. Second, we must address the issue of priorities within each field.

Resources. Next, we need to make better use of the resources that we do get. There are several dimensions to this. The first is a policy and program-management issue: Although we cannot (and should not) reverse the spread of research to more and more campuses, that doesn't mean every campus aspiring to eminence in research has to be comprehensive. We ought to be encouraging different clusters of excellence at different campuses. And we could proceed to do this if proposals were to be judged not on intrinsic merit alone, but also on context: Is the work linked to or synergistic with other work on the campus? Will it help to build a particular set of strengths there? Such a policy would be conducive to a strong, dispersed academic research system that yet allows no more than a healthy degree of redundancy across all institutions.

Another dimension of resource use is the local management of resources—and by that I mean such things as equipment, space, and services, as well as the direct efforts of the research team itself. I am sure that on most campuses there are great opportunities for more sharing of equipment, more effective utilisation of space, mid less expensive ways of procuring needed services. For example, when granting money for new equipment, agencies might ask what the plans are for sharing it and for its down-stream use. Addressing these issues wisely can help researchers; yet, at present, there are virtually no forces in the academic environment—short of crises—that motivate either the administration or the faculty to address them. I believe that it would be valuable if a task

force—formed by one or another of the college consortia or under the auspices of the National Research Council—were to visit many campuses, identify the best practices there, and then widely disseminate this information.

Research and education. **One** of the arguments of the AAAS report is that austere levels of funding will discourage graduate students from pursuing research careers in academia. Yet, ironically, some of our problems arise from the already-existing separation of an increasing portion of academic research from teaching.

Today, the tendency is to use nonfaculty, doctoral research people on research grants—not graduate students, let alone undergraduates—because that arrangement produces results more quickly, leading to more and earlier publication, and a better chance of getting future renewals and new grants. This bias could be corrected by policies of the granting agencies—a shift back to fellowships and traineeships, for example, that provided research opportunities for students. Similarly, changes such as the recent National Science Foundation (NSF) requirement that grant applications include a list of graduate degrees produced by principal investigators and that they list only their 10 top publications (instead of the usual list of dozens or even hundreds of publications) would let reviewers see the educational as well as the research output of the applicants.

There are a lot of other policies of funding agencies that constitute implicit as well as explicit biases against the educational function of research in academe; we should institute a study by either the National Science Board, the National Research Council, or the President's Council on Science and Technology to identify all of them and to recommend appropriate changes. But equally important is the bias of research universities themselves against teaching in favor of research. It is reflected, for example, in the salaries of faculty: Those who spend as much as 80 percent of their time teaching at doctoral universities make from one-tenth to one-third less than those who spend only 20 percent teaching.

New Ideas. Finally, we need to develop innovative ways to make research spending more appealing and productive—programs that fit agency missions and capture the attention of the right appropriations subcommittees in Congress.

Consider one such success story: At NSF, the invention of the interdisciplinary research centers—the Engineering Research Centers and the Science and Technology Research Centers—brought many millions of dollars into NSF budgets that would not otherwise have been there.

What are some other new ideas? Robert White (President of the National Academy of Engineering) has suggested a couple that sound attractive to me. One is to provide the equivalent of DOD's Independent R&D funds to academic institutions doing federal research. These funds, equal to a certain percentage of federal R&D contracts and awards, could be used by the institution for unrelated programs—and be a stimulus for the exploration of new fields. Or, institutional grants linked to broad goals—not specific research areas—could be awarded competitively, again permitting local flexibility.

Another idea is to require megaprojects—space station, superconducting supercollider, strategic defense initiative—to contribute to the development of the human resources that they "con sume." These projects should help support academic programs that contribute to the education and training of the people they need.

Leon Lederman (president of AAAS and author of the abovementioned report) has said that everyone falls into one of two "gangs." The first says "There are finite resources, so science must make hard choices. Scientists must not behave like special pleaders." Meanwhile, the second gang says "Science has always been one of the best investments the government can make," and it is not above pleading on that basis. I believe that the future success of the science enterprise will depend on our ability to merge those two gangs into one unified force that understands both the great value of science to our society and the need to fulfill that promise with fewer resources than we'd like. Unless we collectively take that as our challenge, we will fail ourselves and fail the society that depends on what we do.

Taking a cue from John F. Kennedy's inaugural speech, our clarion call should not be "Give me what I'd like to have to make me happy" but rather "Give me the means to contribute what society needs from me."