SCIENCE & TECHNOLOGY

the United States spent about $40.8 billion in public and private funds for research and development in 1977, up 9 percent from the $37.3 billion spent in 1976, or an increase of 3 percent in constant dollars. The federal government's share was about $21.8 billion.

These figures may inspire complacency, says Cowen. But the NSF has warned that the limited growth of basic research support in constant dollars (up an average of only 1 percent per year from 1968 through 1975) threatens the well-being of American science, especially when declining college enrollments mean a shrinking pool of scientific talent.

There are other problems besides insufficient funding. "Excessive caution, overregulation and anti-intellectualism also undermine our technological enterprise," Cowen contends. There is suspicion of scientific and technological activities not just from the public (e.g., community efforts to regulate research on recombinant DNA) but from the ranks of science itself (e.g., the efforts of so-called "concerned" scientists to restrict research on the possible connection between intelligence and genetics). All in all, there is trouble ahead for basic science and technical innovation in America.

Protesting Abuse of Scientists

"Science, World Politics, and Human Rights" by Richard J. Seltzer, in *Chemical and Engineering News* (Feb. 20, 1978), 1155 16th St. N.W., Washington, D.C. 20036.

The abuse of science and scientists for political ends, and the backlash this has provoked, threaten to disrupt international scientific relations.

Among the most glaring issues are the denial of scientific freedom and human rights to scientists, especially in the Soviet Union and Argentina; the banning of Taiwanese, Israeli, and South African researchers from world scientific meetings; the politicization of UNESCO and other science-oriented UN bodies; and the use of psychiatry and mind-altering drugs for political repression.

These abuses, says *Chemical and Engineering News* staff writer Seltzer, have provoked a fundamental shift in attitude and behavior by many scientists and some scientific organizations. Sporadic and sometimes largely symbolic measures such as letters of protest or petitions are giving way to systematic efforts to monitor and correct repressive policies. Both the U.S. National Academy of Sciences and the American Association for the Advancement of Science are organizing on-site investigative visits to countries accused of denying human rights to scientists. The American Psychiatric Association is setting up a permanent committee to deal with abuses of psychiatry or psychiatrists anywhere in the world.

The effects of such moves on international scientific relations may be substantial. Already an estimated 10 percent of U.S. scientists refuse to participate in exchange programs with the Soviet Union. The 35,000-member Association for Computing Machinery, for example, cut ties

with the Soviet Union following the arrest of Moscow computer scientist Anatoly Scharansky. Some 30 U.S. Nobel laureates in science began boycotting UNESCO activities after that organization castigated Israel in 1974 and 1975.

Do American protests and sanctions do any good? Opinions vary, says Seltzer. Some scientists fear that denouncing repression may encourage the very politicization of science they seek to prevent. But advocates argue that defense of scientific freedom and the pursuit of knowledge are—or should be—the primary missions of scientific societies.

RESOURCES & ENVIRONMENT

Forecasting a Warmer World

"What Might Man-Induced Climate Change Mean?" by Charles F. Cooper, in *Foreign Affairs* (Apr. 1978), 428 E. Preston St., Baltimore, Md. 21202.

Carbon dioxide makes up only .03 of 1 percent of our global atmosphere, but without this slight CO_2 envelope to keep heat from being radiated out into space, the earth would be 10 degrees centigrade colder. This is known as the "greenhouse effect." As the burning of oil, gas, and coal increases the level of carbon dioxide in the atmosphere, the temperature of the earth may rise sufficiently to cause major economic and perhaps political consequences by the year 2000.

While all the effects of an increase in atmospheric CO_2 are still a matter of speculation, says Cooper, plant ecologist at San Diego State University, the increase itself is not in question; the upward trend now runs about .7 percent per year. This means that a doubling of the preindustrial CO_2 level (300 parts per million before 1890) may be expected between 2020 and 2040, raising the mean global temperature by 1.5 to 3 degrees centigrade. At the same time, as global warming draws greater water vapor from the land and oceans into the atmosphere, total precipitation will increase by an average of 7 percent.

A rise of as little as 1 degree centigrade in the mean global temperature would significantly affect growing seasons and rainfall patterns. Because temperature increases would be greater at high latitudes than at points near the equator, some nations would be gainers and others losers. Substantial areas of northern Russia, for example, would become available for crop production. Monsoon areas (India, Vietnam) would also benefit. But in the United States, corn production would drop 11 percent for every 1 degree centigrade rise in average temperature during the growing season. Grain-growing states like Kansas and Oklahoma would become dangerously exposed to drought.

How will the affected nations react? Cooper calls for more research to "limit some of the uncertainties which now make informed political