

sign features each nation has to offer, such as the British armor, the German 120-mm gun, and the American gas turbine engine, have at least been made available for common use.

On the debit side, however, is the fact that the two strongest members of NATO have spent many millions of dollars, as well as time and expertise, to produce essentially equivalent products. From the point of view of the alliance, the XM-1 and Leopard 2 programs represent an almost wholly useless duplication of effort.

If a single tank had been chosen, unit production costs, particularly for Germany, would have been far lower, and for the same overall budgets both countries could have built more tanks.

With a single tank, logistics would have been greatly simplified. If diversity were required, it could have been obtained far more efficiently than at present by building different models of the same basic tank, exactly as Detroit does for

automobiles. Another military disadvantage is the failure to come to a clear agreement on the best size of gun, which has opened up yet another area of de-standardization.

The political effects of the tank decision have not been particularly happy. Since European countries have weaker defense industries, it is not too often they emerge with a product of comparable quality to its American counterpart. The Leopard 2 was one of the few military products that clearly was competitive. To Europeans watching for a signal of American intentions toward the "two-way street," the message could not have been clearer.

If the Germans were disappointed, the British have also given vent to occasional unofficial mutterings. Although Chobham armor, according to the General Accounting Office, is "the most distinctive feature" of the XM-1, the British government is not collecting a cent. The secret of the armor was given for free in the

belief that the terms of an unpublished Anglo-American research agreement left no alternative. A recent article in the London *Sunday Times* argues that in fact there was a loophole in the agreement which would have allowed the armor to be shared with NATO allies on a commercial basis. "We have been boy scouts in this affair. It is time we grew up," a British general was quoted as saying.

Department of Defense officials say the Army has developed a different version of Chobham armor; the British received data about ammunition and other research, although not on a quid pro quo basis.

The problems in achieving NATO standardization are easier to describe than the solutions. In the case of the tank, a technical success has been achieved at the expense of military, economic, and political benefits. NATO could afford these inefficiencies—once upon a time.—NICHOLAS WADE

Costs of Environmental Regulation Draw Criticism, Formal Assessment

Two months ago Robert S. Strauss, the President's counselor on inflation, caught the public's attention by naming environmental regulation as one of the top priority targets in the fight against inflation. The reaction of environmentalists and of officials such as Douglas M. Costle, administrator of the Environmental Protection Agency (EPA), was sufficiently sharp that Strauss backed off a bit, but the issue he had raised was still left front and center. Are environmental regulations really inflationary, and, if so, what can and should be done about this problem?

The economic stabilization subcommittee of the House Committee on Banking, Finance, and Urban Affairs is seeking answers to this question as well as to others bearing on the cause of inflation and the cure. On 21 June, the subcommittee, chaired by Representative William Moorhead (D-Pa.), received the testimony of Barry P. Bosworth, director of the Council on Wage and Price Stability (CWPS), and was later to hear from Barbara Blum, EPA's deputy administrator.

One thesis to emerge from these hearings was that, while government regulation is not among the major causes of inflation, it does contribute as much as 3/4 of a percent annually to the increase in the Consumer Price Index, which this year is expected to go up about 7 percent. Bosworth holds that a contribution of 3/4 of a percent is plenty significant, especially inasmuch as compensatory increases (as in prices and salaries) that stem from it "double the original impact within 2 years."

Blum, in prepared testimony which she was scheduled to give before the subcommittee on 29 June, holds in effect that the part of the increase in the CPI which can be attributed to environmental regulation does not fit the classic definition of inflation, a term that connotes paying more without getting anything more or better in return. According to Blum, such economic studies as are now available "tend to support our judgments that the benefits of our regulations outweigh the costs." Then, for emphasis, she observes that episodes such as the Kepone contamination of the James Riv-

er in Virginia (where most of the fishing interest has had to be shut down) are grim evidence that the costs of pollution can vastly exceed what it would have cost to prevent it.

But Blum acknowledges, by implication if not in so many words, that to the extent that environmental regulation fails to follow the most cost-effective strategies, it adds needlessly to the costs that industry—and ultimately the public—must bear. EPA, she says, has been a leader in doing economic analysis of its regulations and in exploring ways to lower regulatory costs without significant loss of environmental protection. The CWPS has frequently praised EPA for the quality of its economic studies, she adds.

Bosworth described for the Moorhead subcommittee the elaborate mechanism which the Carter Administration has established for the review of proposed regulations from the standpoint of potential economic impact. Early in the Ford Administration, Congress, acting at the President's request, passed a law requiring an economic impact analysis of major regulatory actions. But, as things turned out, most of these impact studies did not come out until several months after final promulgation of the regulations in question.

In an effort to improve on this largely fruitless effort of his predecessor, President Carter last March issued Executive Order 12044. Among other things, this

order provides that a "regulatory analysis" setting forth a careful comparison of alternatives and their economic consequences shall be conducted for all pro-

posed regulations deemed likely to have an effect of \$100 million or more on the economy annually or lead to a substantial increase in costs or prices for

particular industries, levels of government, or regions.

To complement the order, the President set up the Regulatory Analysis Re-

DOD Vacillates on Wisconsin Cryptography Work

Questions about the implications of academic research on cryptography were raised anew in recent weeks when the government placed, and then lifted, a secrecy order on a professor of computer science at the University of Wisconsin at Milwaukee.

George I. DaVida, the professor, had applied for a patent on a new cryptographic scheme to the Commerce Department. But in late April, he received a letter from the department ordering him not to discuss or write about the "principles" involved.

"It was worded so broadly," DaVida told *Science*, "It could have meant that I couldn't talk about any of the mathematical theory underlying cryptography or my related research." DaVida declined to discuss the specific scheme in the patent, saying that his attorneys had advised him to remain silent about it until after the patent process, now under way, is complete.

But at the time, Werner Baum, chancellor of the campus at Milwaukee, was outraged at what he regarded as an invasion of his faculty's academic freedom without due process. Baum told *Science* that the government's procedure smacked of McCarthy era tactics against universities, and that the law the commerce department acted under dated from that era and might not survive a test of its constitutionality. "How can some unknown bureaucrat classify an individual's research activity without any justification or due process?" he said.

Baum protested the secrecy order publicly, spoke to the Secretary of Commerce by telephone, and appealed to the director of the National Science Foundation (NSF)—which sponsors DaVida's work—for aid in fighting the order. A few weeks later, DaVida received another notice saying that the secrecy order had been lifted.

According to government officials close to the incident, the Commerce Department forwarded the patent application to "a defense agency" for review. The official would not say which agency was involved, but presumably it was the National Security Agency (NSA), the Department of Defense's (DOD) cryptographic organization, which operates in total secrecy (it is not even listed in the Pentagon directory) and is accustomed to total secrecy and a monopoly on the subject of cryptography.

Because the University of Wisconsin's patent applications are filed through an organization not bearing the university's name, that is, the Wisconsin Alumni Research Foundation, and because DaVida's application did not mention that his work had been sponsored by NSF, these officials say that the "DOD agency" reviewing the patent didn't know they were dealing with university research.

The NSA, through spokesperson Carolyn Johnson, declined to comment on the incident, but a Senate Intelligence Committee staffer says:

"Anything dealing with encryption is sent to the DOD to see if the patent applied for is harmful to national security. The DOD made a decision that national security could be

harmful by its publication and placed a hold on the application and froze it. . . .

"When the university made known its interest in the patent application, a review was made and they—the DOD—came to the conclusion that the degree of potential damage was one that could be tolerated. The second review rolled back the first hold."

Baum is still not satisfied. In a 19 June letter to NSF director Richard C. Atkinson, he wrote:

"At the very least, an effort should be made to develop minimal due process guarantees for individuals who are threatened with a secrecy order. The burden of proof should be on the government to show why a citizen's constitutional rights must be abridged in the interests of 'national security.' Perhaps a judge, not some unknown 'defense agency' should determine the validity of the government claims. Without such protection, both individual rights and scientific research may suffer irreparable damage."

How to Police Research?

The incident is the second sign that the defense side of the government is concerned and jittery about what fruits the recent growth in university research in cryptography may bear. A group of scientists who have pioneered a breakthrough in cryptography by developing secure codes that could be used by business and the public, last fall, received a letter from J. A. Meyer, an NSA employee, warning them that to publish or talk about the work could violate the export control laws. The NSA disavowed responsibility for the letter and the scientists have continued to publish and talk about their work unharmed (*Science*, 30 September 1977).

The Meyer incident raised the issue of whether the export laws could apply to university research; the DaVida affair raises the question as to whether the patent laws can be used by the defense community to police discoveries.

The NSF's General Counsel, Charles H. Herz, had meetings with attorneys from the Commerce Department and from "a defense agency" concerning the DaVida patent. Herz says "Maybe patents aren't the way to police this thing. . . anything in a patent that arises from university research has probably already been published."

Herz' impression that the "defense agency" is looking for some clear way to evaluate the jewels that could be thrust up from this research—and prevent other nations from obtaining them—is shared by the staffer on the Senate Intelligence Committee. "They realize they have neither the ability nor the legal authority to police it [the academic research] or stop it. All they would like is some clear authority, so that if something comes out of the universities that really does threaten national security, they could move in on it. Suppose a mathematician came up with a brilliant way to crack the most secure codes, for example. They would want that line drawn."—DEBORAH SHAPLEY

view Group (RARG), which is headed by Charles L. Schultz, chairman of the Council of Economic Advisers (CEA), and includes among its other members representatives of about a dozen economic and regulatory agencies. An executive committee selects 10 to 20 regulatory analyses a year (with no more than four from any one agency) for review by the analysis review group as a whole because of their inadequacy, large po-

tential economic effect, or whatever.

The CWPS prepares a draft report on all regulatory analyses chosen for such review, and, once accepted by RARG, this report goes into the public record along with all other comment by government agencies and private parties on the proposed regulation.

The final upshot of such a review may be a decision by Schultz, as chairman of RARG, to intercede personally in an at-

tempt to have the proposed regulation modified or withdrawn. He could either meet personally with the head of the agency involved or even take the matter to the President.

The RARG mechanism has not existed long enough to have really been tested. The only environmental regulation to undergo a formal review by the new group so far is one proposed by the Occupational Safety and Health Administration

Briefing

Social Security Computers Vulnerable, GAO says

The Social Security Administration's (SSA) vast computer network, which authorizes the distribution of \$103 billion each year to one out of every seven Americans and keeps records on nearly all Americans, is vulnerable to electronic snoopers, dishonest employees, bogus beneficiaries, and even janitors and repairmen, according to a report by the U.S. General Accounting Office (GAO) released on 5 July.

The report includes a long list of security problems in the system, which consists of a central data bank in Baltimore that can be "accessed" by any one of the 3700 terminals located in more than 1300 regional, district, and branch offices around the country.

The terminals are capable of both creating and changing records in the central data bank.

Spokesmen for the SSA say that since the GAO investigators made their visits to field offices, security has been heightened. The report is the result of an investigation that lasted more than 2 years and was sought by John E. Moss (D-Calif.) and Charles Rose III (D-N.C.).

"The data banks maintained by SSA constitute a large national resource that must be safeguarded against alteration, destruction, abuse, or misuse . . . [M]any other government agencies, as well as industry, rely on information generated from these automated data banks in managing their operations," the report says. "The personal files . . . are valuable to the workers and their families in that they contain private personal information gathered to support present and future payments made under Social Security and Medicare." For these reasons, it says, the accuracy and integrity

of these files should be closely guarded.

However, it says, the system was designed for ease of use and speed of service to the beneficiaries—the elderly, the disabled, and the poor, many of whom rely on SSA for their income—rather than with security considerations in mind. Noting that SSA plans to expand its 3700 terminals to 4600 and eventually to 35,000, it urges that the expansion "include systems changes to correct existing security deficiencies."

The report states that the physical security of the 1300 field offices where these terminals are located is not strong; some are not even locked at the end of the day, and "whereas some offices have their terminals in a separate, locked room within the office," other "offices have dispersed terminals throughout the office and reception areas in order to better serve the public . . . [which] leaves the automatic system open for possible use by those who have access to the office," including the public, janitors, landlords, and other non-employees. The manual files which contain beneficiary records at each field office—and thus contain personal, health, and financial information—are left lying around in the open where anyone could view or take them.

An insecure feature of the computer system, the report says, is that the majority of terminals have the physical capability of not only accessing, but creating and changing files. "A user at any of these terminals can access and make changes to the millions of active beneficiary records stored with the national data bank," it says. Even though employees are instructed to perform more limited functions—such as only retrieving information—the system itself allows them to perform more important tasks if they so wish. The terminals also include a feature that provides "cash payments" to beneficiaries in cases where the need is deemed "critical"—a feature that could lend itself to abuse by employees.

The report noted one press story in which an SSA employee told the computer that a beneficiary had moved, when in fact he had died, so that the computer went on authorizing payments to be sent to the new, false address—netting the employee \$20,000 before he was caught.

The report also criticizes SSA's level of employee security, noting that the administration does not make background checks on employees before they are hired, and that "passwords" for accessing the computer system, which should be frequently changed, are changed only rarely and not when employees who know them leave their SSA jobs.

Toni Lenane of the SSA's Office of Program Operations, which is in charge of the security of SSA computers, says several steps are under way to tighten the system's security. For one, the central system can now "lock" terminals electronically at closing time each day, solving the problem of after-hours security in the field offices. Another program being added to the system will require that an individual user at a terminal be personally cleared by the central system before he can access the central files. Also, high-level officials responsible for security are being hired in Washington and in branch offices.

Mad at the Soviets?

Try the Chinese

Next to athletes, scientists are perhaps the most useful group of U.S. professionals for warming up ties with distant, politically remote lands. This happened in 1971, when a group of nongovernment scientists became the first Americans to visit the People's Republic of China, following on the heels of an American Ping Pong team. President Nixon's historic

(OSHA) to establish more stringent exposure limits for the bulk industrial chemical compound acrylonitrile, a suspected carcinogen.

And up to this point, the RARG review of this matter has gone no further than the filing of the CWPS report as a part of the OSHA rule-making record. OSHA has taken sharp exception to some of RARG's conclusions, contending, for instance, that there are not

enough reliable data available to attempt to quantify the cancer risks associated with various levels of exposure to acrylonitrile. (The widely publicized dispute within the Carter Administration over cotton dust exposure standards and their economic impact on the textile industry was never dealt with by RARG as such, for the standards were proposed by OSHA long before this review group existed. A compromise said to be ac-

ceptable both to OSHA and the economic agencies such as CEA was finally reached, and the cotton dust standards have now been issued.)

The RARG executive committee has considered three EPA regulations, having to do with restrictions on synthetic organic chemicals in drinking water supplies, guidelines for pretreatment of discharges in municipal sewer systems by electroplaters, and the prevention of sig-

Briefing

journey to Peking to resume relations with that country followed.

Something of the same sort may be taking place now. The White House has announced that a group of high-ranking U.S. science officials will visit Peking for several days, in early July.

The 14-member delegation will be led by Frank Press, science adviser to the President, and include such people as Richard C. Atkinson, director of the National Science Foundation, Robert A. Frosch, administrator of the National Aeronautics and Space Administration, and Donald S. Fredrickson, director of the National Institutes of Health.

The trip will differ from previous Chinese-American scientific visits, which since 1971 have been conducted under private or semiofficial auspices, mainly under the aegis of the Committee on Scholarly Communication with the People's Republic of China, made up of the National Academy of Sciences and two other scholarly organizations. The rationale for these semiofficial visits has been that government-to-government science exchanges would have to await the normalization of relations between Washington and Peking. Clearly, then, the President's decision to go ahead with governmental science contacts could be a signal that the United States and China are moving closer to formal relations.

According to the White House, plans for the visit were first discussed with the Chinese during National Security Adviser Zbigniew Brzezinski's trip to Peking in late May.

The China trip was announced at a time when numerous American scientists, both in and out of government, are voluntarily deciding to not continue their cooperative endeavors with Soviet scientists or travel on scientific exchanges to that country. This severance of ties has not been officially orchestrated, apparently, but has developed voluntarily at

the grass roots by working scientists upon whose interest the government exchange program with the Soviets depends. It has been largely a reaction to the sentencing of Yuri Orlov, a Soviet scientist whose fair treatment by the Soviet authorities had become a cause among Western human rights and scientific organizations.

Soviet leader Leonid Brezhnev has not been blind to the implications of the American scientists' trip. He is reported to have denounced it as "a short sighted and dangerous policy. . . . I hope its authors do not have to bitterly repent it."

But presidential press secretary Jody Powell, probably speaking as much with Brezhnev in mind as the group of reporters before him, said the 4-day visit was not intended as a signal to the Soviet Union or an attempt to play the Soviets and Chinese off against each other.

Boland Committee Cuts NSF Research Funds

On 19 June, the House of Representatives voted an appropriation for the National Science Foundation (NSF) of \$806 million dollars, or \$44 million less than the foundation had requested. The cut had originated in the subcommittee headed by Representative Edward P. Boland (D-Mass.) of the Appropriations Committee, and was sustained by the full committee before also being approved by the House. The cuts were centered on the latest version of the Rann program, which is now known as the Applied Science and Research Applications (ASRA) Directorate, which the Boland subcommittee evidently thinks has been biting off more than it can chew.

Although the cut still leaves the NSF some \$23 million ahead of its fiscal 1978 appropriation of \$783 million, the effect of

the cut will probably be to reduce the final, fiscal year 1979 figure from the generous \$850 million that the Administration requested. The Senate, once it gets to work on the NSF appropriations bill in August, is expected to uphold this figure and compromise with the House.

The House Appropriations Committee report on the NSF budget, and staffers for the Boland subcommittee explain that, while the committee approves of the generous increases the Administration has sought for research in the mission-oriented agencies, it does not necessarily follow that NSF is automatically entitled to a boost above a level that will compensate for inflation.

Too often, the report states, the NSF applied research has overlapped with the work of other mission agencies, such as in earthquakes, water management, and social science.

The report fingered NSF's economic studies as funded by its Biological, Behavioral, and Social Sciences Directorate, saying "it is difficult to believe that these . . . are basic research efforts whose primary aim is advancing the discipline of economics." And, in the ASRA Directorate, the committee slashed earthquake policy research by \$9 million from the request (the largest cut in any single program) because of "lack of effective management control of grant awards" by the NSF.

The cuts Boland did not specify would entail a reduction in some basic research areas, NSF says.

Since the Boland subcommittee successfully cut the NSF appropriation request last year as well, the reduction seems to serve as a bellwether of feelings and frustrations about science in the House.

It might be noted on the plus side, however, that the subcommittee, after cutting other programs, increased the request for science education, which is perennially popular among House members.

Deborah Shapley

nificant deterioration of air quality in clean air regions. In the case of the first two regulations mentioned, the executive committee concluded that EPA's own analysis of the economic impact was satisfactory.

In the case of the proposed "significant deterioration" regulation, which has now become final, the public comment period had closed before the committee took it up and, for this reason, it was never formally placed on the RARG agenda. Nevertheless, numerous discussions took place among people at EPA, CEA, and CPWS, with the result that EPA finally decided to change the scope of its original proposal in a way that reduced its coverage of affected companies by half, yet "without any sig-

nificant increase in emissions expected."

The next big EPA regulatory proposal likely to be taken up by RARG will be the one (not yet issued) for new source performance standards (NSPS) for large fossil fuel boilers. Already, economists at CPWS are using preliminary air quality modeling data from EPA and the Department of Energy in an attempt to see what standards will make the most sense economically as well as environmentally.

Environmentalists such as Robert Rauch, an attorney with the Environmental Defense Fund, believe that the new economic and inflation review process leads to legal or procedural improprieties when pressures are applied to regulatory agencies such as CEA or

CPWS either before a regulation has been formally proposed or after the public comment period has closed. Rauch is convinced that issuance of the proposed NSPS regulations would not have slipped several months behind schedule had EPA not felt under strong pressure to moderate the standards with a view to accommodating greater coal consumption.

Yet, in principle, the testing of proposed environmental regulations against standards of economic efficiency is hard to fault. Or at least it is so long as those doing the testing are committed to the Carter Administration's stated determination not to sacrifice environmental quality to economic expediency.

—LUTHER J. CARTER

RESEARCH NEWS

Climate Control: How Large a Role for Orbital Variations?

Variations in the earth's climate occur from year to year, over periods of hundreds of millions of years, and on every time scale in between. Climatologists have known that some of this variability is not random, but that it occurs in more or less regular cycles, such as the comings and goings of the ice ages. But researchers have generally been at a loss to explain how these cycles are controlled.

A 150-year-old theory of climate control, now known as the Milankovitch theory, has recently gained widespread acceptance as a factor in the long-term variation of climate over the last several hundred thousand years. The theory holds that regular, easily predicted changes in the orientation of the earth's axis of rotation and the shape of its orbit affect the distribution of sunlight over the earth. This varying distribution would then control the timing of glacial epochs. Only within the last few years has convincing evidence been extracted from the geological record to support the contention that the predicted climate variations actually occurred.

Even though a link between orbital variations and climate has finally been generally accepted, there is still doubt among many researchers as to whether the Milankovitch theory can fully explain the observed variations or only a small portion of them. Part of the problem is that studies of deep-sea sediment cores have revealed not only the 23,000-year and 41,000-year climatic cycles predicted by the theory, but also an unex-

pected 100,000-year cycle that dominates the two shorter cycles. In addition, it is not yet known how much of long-term climate variability can be accounted for by these three cycles.

The first suggestion that orbital variations might affect climate was apparently made in 1830 by the astronomer John Herschel. The idea was not forgotten, having been refined several times since. It was most recently revived by Milutin Milankovitch, a Serbian, who published detailed calculations in 1941. But there have always been a large number of competing theories. These include theories that invoke factors external to the climate system, such as changes in the light output of the sun, the concentration of interstellar dust, the earth's magnetic field, or the amount of volcanic dust injected into the atmosphere. Researchers have also considered the possibility that an active component of the climate system, such as the continental ice sheets themselves, might respond to the rest of the system by cycling with its own characteristic periodicity. Of all these proposals, only the Milankovitch theory has been supported so far by substantial physical evidence. This may be because it is the only theory that can be used to predict precisely the duration of periodic changes in climate.

Exact predictions of periodicities are possible because they depend on characteristics of the earth's axis of rotation and orbit that are readily calculable far into the past. The tilt of the earth's axis

away from the plane of the earth's orbit, the obliquity, is now 23.5°, but it slowly varies between 22.1° and 24.5°, completing one cycle every 41,000 years. Since it is obliquity that causes the seasons, a cyclic variation in the obliquity produces a cycle in the strength of the contrast between seasons.

While this gentle nodding of the axis occurs, the axis also precesses, or changes its direction. At the moment, the axis points in the direction of Polaris, the North Star. As the axis precesses, it describes a circle among the stars. Precession also affects the contrast of the seasons because it determines at what point on the earth's elliptical orbit winter and summer occur. Winters occurring near the earth's closest approach to the sun would be warmer on the average than those occurring at its farthest point. Spring and fall seasons would be proportionately cooler. The precession cycle has a period of about 21,000 years.

The ellipticity, or eccentricity, of the earth's orbit is not constant, either; it varies in a 105,000-year cycle. According to the Milankovitch theory, this cycle should only modulate the size of the precession effect, and should cause no significant climate cycle of its own.

Neither the 41,000-year obliquity cycle nor the 21,000-year precession cycle involve a change in the total amount of sunlight falling on the earth, as a change in the output of the sun would. Rather, they affect how much sunlight a particular latitude receives at a