

to cease all physical experiments, no matter how small their yield, whose primary purpose is to design new types of nuclear weapons, as opposed to developing peaceful uses of nuclear energy. Indeed, if I were President, I would not fund computational experiments, or even creative thought designed to produce new categories of nuclear weapons. After all, the big secret about the atomic bomb was that it *could* be done."

Bethe proposed that the President, the weapons lab directors and the scientists in those labs should "cease and

desist from work creating, developing, improving and manufacturing further nuclear weapons—and, for that matter, other weapons of potential mass destruction such as chemical and biological weapons." This is the same stance taken two years ago by the Atomic Scientists Appeal to Colleagues, organized by the FAS.

Despite Bethe's argument that "enough is enough" in nuclear arms, he told Clinton he "fully supports science-based stockpile stewardship, which ensures that the existing nu-

clear weapons remain fully operative, [and] neither it nor any of the other Comprehensive Test Ban Treaty safeguards require the laboratories to engage in creative work or physical or computational experiments on the design of new types of nuclear weapons, and they should not do so."

Sources at the White House say Clinton has read the letter and sought advice from the Pentagon, Energy Department and independent experts on what action, if any, to take in response.

IRWIN GOODWIN

Japan's Worries About Its Neglect of Scientific Research Lead to New Collaborations with Brookhaven and NASA

Japan's neglect of basic science seems a paradox given the nation's cutting-edge technologies. It is a leading producer of semiconductor chips, optics, composite materials and flat-panel screens used in laptop computers. In addition, its educational system turns out some of the world's highest-scoring students in math and science. But while Japan runs a huge trade surplus with the US and the rest of the world, it runs a large deficit in intellectual property in the form of patent licenses and royalties that are essential for developing new technologies. So it was not surprising that the government produced a plan last year to increase R&D spending dramatically each year through 2000 (see *PHYSICS TODAY*, October 1996, page 59). But after a series of financial and political perturbations, Prime Minister Ryutaro Hashimoto, confronting a \$2 trillion debt, declared in April that reducing the country's budget deficit would be his top priority and that R&D budgets would not go unscathed. Nonetheless, two research programs with the US would go forward as planned.

One involves Brookhaven National Laboratory as the site of a new research center financed by a collaboration with Japan's Institute of Physical and Chemical Research, known as RIKEN. The purpose of the center will be to study spin-polarized proton physics in conjunction with the lab's new Relativistic Heavy Ion Collider (RHIC). Japan will put up \$2 million this year for the RIKEN-BNL Research Center and considerably more in succeeding years, according to Peter Bond, chairman of Brookhaven's physics department. The center, to be opened in September in the physics building at Brookhaven, will host 30 to 40 nuclear theorists recruited from around the world.

The idea for the collaboration originated two years ago when nuclear

physicists at RIKEN recognized that the \$500 million RHIC—an accelerator that will collide two beams of gold ions at a combined energy of 200 GeV/nucleon to produce quark-gluon plasma—could be ideal for investigating the spin structure, or intrinsic angular momentum, of particles within the atomic nucleus. RIKEN then contributed \$20 million worth of magnets and detector components for RHIC.

Then, a year ago, on a trip to Japan, Tsung-Dao Lee of Columbia University convinced RIKEN officials to fund an international research center at Brookhaven. The concept of the center, Lee told them, would be Japan's affirmation of "the universality of science."

Lee, who will be the center's director, has a long connection with Brookhaven going back to the mid-1950s, when he and Chen Ning Yang, now at the State University of New York at Stony Brook, worked out their then-heretical analysis of the nonconservation of parity in weak interactions, in studies performed at the lab.

In announcing the new center, RIKEN's president, Akito Arima, noted: "The center is clearly a highly significant landmark in our effort to promote international collaboration." As for the appointment of Lee, Arima added, "He brings world-class status to the center, together with a proven ability to play a vital role in leading the way towards truly outstanding science. Great opportunities must surely lie ahead."

RIKEN, located north of Tokyo, has attached no strings to its contribution. There are no obligations to purchase instruments from Japan, for example, or to set aside a number of positions for Japanese scientists. The initial budget for the center was approved by the Japanese Diet as part of an enlarged research appropriation for this fiscal year, which began on 1 April, and

the government gave its assurance of continued support. Japan's Science and Technology Agency, which funds RIKEN, will also equip the center with a dedicated supercomputer capable of operating speeds of 600 gigaflops (600 billion floating point calculations per second). This machine will operate in tandem with a parallel processor of 400 gigaflops at Columbia University's physics department.

Lee is enthusiastic about placing the center at Brookhaven because "it allows for an immediate exchange between theorists and experimentalists," he said. "Progress in physics depends on young physicists opening up new frontiers." Thus, Lee observed, the center "will be dedicated to the nurturing of a new generation of scientists who can meet the challenges that will be created by RHIC." The center's first group of researchers will consist of six theorists, who have already been selected for temporary appointments from 106 applicants. A group of experimentalists will be chosen next year, in time to do their work when RHIC begins operations in 1999.

The second US-Japan collaboration is a space mission to collect samples from the surface of a small asteroid and bring these back to Earth for study. The mission is scheduled for launch on a Japanese spacecraft in January 2002 from Kagoshima Space Center and should take 20 months to reach Nereus, a near-Earth asteroid reckoned to be 1 km in diameter. Discovered in 1982, the asteroid has an orbit that, at its closest point to the Sun, takes it just inside the orbit of Earth.

"It will be a world first," says Akira Fujiwara, a planetary scientist at Japan's Institute of Space and Astronautical Science (ISAS), who is leading the scientific aspects of the mission, known as MUSES-C. Fujiwara expects the samples to provide insights into the

materials and conditions that formed the rocky inner planets of the solar system more than four billion years ago. "These asteroids are the fossils of our own solar origins," he says.

MUSES-C will hang around the asteroid for two months, making three landings to drop off a sample-collecting robotic rover built by NASA's Jet Propulsion Laboratory. The rover, weigh-

ing only 1 kg, will be the smallest ever deployed in space, says Jürgen Rahe, head of NASA's solar system exploration program. If all goes according to plan, a reentry capsule laden with samples will parachute to Earth in January 2006.

A cooperative agreement on MUSES-C was signed on 2 May by Atsuhiko Nishida, director general of ISAS, and Wesley Huntress Jr, NASA's

associate administrator for space science. The asteroid rover is a direct descendant of the technology used to build the Sojourner rover that is due to touch down on Mars with the Mars Pathfinder lander on 4 July. The rover for MUSES-C will carry two scientific instruments—a visible imaging camera and a near-infrared point spectrometer.

WASHINGTON DISPATCHES

Science at a Price Since the Clinton Administration's budget request for fiscal 1998 was released last February, leaders of nearly four dozen scientific and engineering societies, as well as some key members of Congress, have issued calls for more funds for R&D programs in nondefense government agencies. Federal funding for such programs, amounting to \$33 billion in proposed outlays next year, has fallen more than 3% in "real" (inflation-adjusted) dollars since 1994. And the bipartisan agreement reached last month by President Clinton and Republican leaders in Congress appears even grimmer for the next four or five years, with a 14% decline scheduled in the protracted effort to eliminate the federal deficit by 2002. Indeed, in the budget category for General Science, Space and Technology, which includes funding for the National Science Foundation, NASA and basic science in the Department of Energy, the budget resolution would authorize a decline from \$16.2 billion next year to \$15.6 billion in 2002 in "as spent" dollars and even more, to be sure, when inflation gnaws away at purchasing power.

So when Franklin Raines, Clinton's budget director, spoke to the President's Committee of Advisers on Science and Technology (PCAST) on 9 June, he delivered some powerful words in a soft voice. Spending for most discretionary programs, which includes all scientific research, will be "very tight," with increases roughly equal to inflation, which has been reckoned at between 2.5% and 3% in the last two years. "But half of the programs will have real declines," said Raines, who came to the Office of Management and Budget at the start of Clinton's second term from the vice chairmanship of the Federal National Mortgage Association, better known as Fannie Mae.

As for those scientists who call for larger allocations for research, Raines said: "The more there is an appeal for more money, the more there is reason to ask, Where should the dollars go?" The country's corporate community has to make funding decisions five to ten years ahead, he observed. "Government needs to make choices about funding discoveries and increases in knowledge." A wish list for research programs among competing scientific constituencies is not helpful, he indicated. What is needed is a fundamental reordering of government priorities and policies for research to meet the fiscal realities. Raines then asked: "How do we get the scientific disciplines together to work out the choices and priorities? Any ideas you might have will be welcome." PCAST members didn't come up with any answers then and there.

Juries of Peers Science is usually portrayed as a noble, inviolate enterprise. To support the concept, scientists point to the peer review procedure—the scientific version of the judicial system's impartial jury of peers. But a paper published in the 22 May issue of *Nature* casts doubt on the peer-review system as the impeccable guardian of scientific integrity. In examining the peer-review operations of the Swedish Medical Research Council, one of the main funding

agencies for biomedical research in Sweden, Christine Wennerås and Agnes Wold, both microbiologists at Göteborg University, found that the success rate of female scientists applying for postdoctoral fellowships in the last six years was less than half that of their male counterparts. The reviewers persisted in overestimating male achievements and underestimating female performance, as shown by multiple-regression analysis, the authors stated. In conducting their study, they were first refused access to peer-review evaluation scores and resorted to legal action to obtain the records. The scores revealed that the peer reviewers "deemed women applicants to be particularly deficient in scientific competence." But when the authors examined the *Journal Citation Reports*, they found women to be virtually equal in productivity and creativity. Their conclusion: "One must recognize that scientists are no less immune than other human beings to the effects of prejudice and comradeship. The development of peer-review systems with some built-in resistance to the weaknesses of human nature is therefore of high priority. If this is not done, a large pool of promising talent will be wasted."

Lobbying for R&D Tax Credits More than a thousand US companies and two dozen trade associations have endorsed a letter to President Clinton and prominent members of Congress urging them to restore the research tax credit that expired on 31 May. Since 1981, Congress has renewed the R&D tax credit seven times, but last year the Republican majority let the credit run out for the first time, as an example of its opposition to "corporate welfare." The credit is "critically important" to supporting R&D, says Bill Sample, senior director of taxes at Microsoft Corp and head of the R&D Credit Coalition, a special interest group that corralled the corporations and associations. As the letter to Clinton and Congress points out, corporate research decisions are usually made in five-year planning cycles and research may take decades to attain technological results, so companies are often reluctant to take on far-out projects "that lead to the next great technology," says Sample.

"American industry is on a worldwide high in the benefits of R&D," Sample observes, "but the uncertainty of the R&D credit is likely to have unintended stop-go consequences." The R&D credit, which costs the government about \$2 billion per year, has a tenfold return, he contends. According to the letter, it is "a critical, effective and proven incentive for companies to maintain and increase their investment in US-based R&D."

The Clinton Administration supports a one-year extension of the credit, and many lawmakers agree. But the business community isn't so sure Congress will approve the credit retroactively because of the all-out push to balance the federal budget. They are especially nervous because the credit was allowed to lapse from mid-1995 to mid-1996 before being reinstated in modified form last year.

IRWIN GOODWIN

Along with the challenge of landing on such a small target, engineers also face the problem of devising an instrument to gather samples when there is insufficient gravity to poke or scrape the surface. The plan calls for MUSES-C to fire a small metal projectile into the asteroid's surface, breaking off fragments with enough force so that some of the bits will scatter and be captured in a funnel-like receptacle on the spacecraft. That technique may yield only one to five grams of asteroid fragments, but Rahe believes the amount should be sufficient to help resolve questions about the materials that make up asteroids and determine if these differ from those of meteorites that have been found on Earth. What's more, studying materials from a known source that has been observed spectrographically could help refine later spectrographic analysis.

The spacecraft itself is another engineering challenge. It will be powered by an ion thruster in which xenon

ionized by microwaves is accelerated by high-voltage electrodes. The technology, which replaces the much heavier solid or liquid fuel in present propulsion systems, has been used before to stabilize thrusters but never to power the primary engine of a spacecraft. MUSES-C also will rely on new sensors and controls to guide its landing on Nereus, and its reentry capsule will require a new type of heat shield to protect it from the much hotter temperatures generated by a higher reentry speed, resulting from its odd trajectory in interplanetary space.

While most of the cost, including that of the \$104 million spacecraft, will be borne by Japan, NASA expects its contribution to be worth about \$20 million. NASA Administrator Dan Goldin believes MUSES-C may be the genesis of a partnership in which the two countries can pool their resources and technology for the expensive business of space exploration.

IRWIN GOODWIN

Washington Ins & Outs

Good Leaves Commerce, Grumbly DOE

After four years as the Commerce Department's undersecretary for technology, **Mary Lowe Good** submitted her resignation, went on a long-planned two-week vacation in China and then, on 3 June, left Washington for her newly renovated, riverside home in Little Rock, Arkansas. Department officials said her abrupt departure was unexpected, and, in fact, Commerce Secretary William Daley forbade any announcement of her resignation for the time being.

Until Good's successor is named, her position will be filled by the deputy undersecretary, **Gary H. Bachula**, a graduate of Harvard Law School and an aide to retired Representative Bob Traxler of Michigan and to former Michigan Governor Jim Blanchard. Bachula was Traxler's chief of staff in 1974–86, advising the congressman on appropriations for the National Science Foundation, NASA, the Environmental Protection Agency and the National Institute of Standards and Technology (NIST). Afterward he served four years as chairman of Blanchard's cabinet council. Prior to joining Commerce, Bachula was vice president for planning and program development for the federally funded Consortium for International Earth Science Information Network (CIESIN). Traxler had been CIESIN's staunchest advocate in the House, where he made sure Congress regularly delivered "pork" to the

organization, which was located in his district.

Good has had a distinguished career in research, teaching, corporate management and government service. After earning a PhD in inorganic chemistry and radiochemistry from the University of Arkansas in 1955, she spent the next 25 years in teaching and research at Louisiana State University and the University of New Orleans, followed by 13 years in industrial research management at Universal Oil Products and AlliedSignal Corp, where she was senior vice president for technology. She was on the board and president of the American Chemical Society (ACS) and a member of the National Science Board and, in 1988–90, its chairman.

In the past few months, congressional criticism has been directed at Good for her determined defense of the Advanced Technology Program (ATP), within NIST. When Republicans took control of the House in 1995, ATP was bashed as "corporate welfare" and threatened with extinction. In contrast with most government R&D programs, ATP is of modest size and means. Its fiscal 1997 budget is \$225 million, which represents a drastic cut of \$120 million from the Clinton Administration's request. To make up the shortfall, the Administration has proposed a hike of \$50.6 million for next year, when other R&D programs are

being held to 3% increases or less. On top of this, the Administration indicates that the program's expected growth will require a \$500 million annual budget at the end of five years. But for now, ATP is under siege, and Mary Good and Arati Prabhakar, who resigned from her position as NIST's chief in April, have been the main targets.

ATP was initiated in 1990 by the Bush Administration to bridge the "innovation gap" between basic research and short-term generic development that could lead to a marketable product. The program requires companies to share the costs and other risks of developing technologies with the government.

While Commerce's own analysis of ATP and numerous anecdotal accounts conclude that the program is successful in the short run at creating new products, new high-wage jobs and new alliances for industry, universities and government, there are serious arguments raised against the government's funding of ATP or any similar program. After quarreling with Good at a hearing on the program in April, Representative Harold Rogers, the Kentucky Republican who chairs the House Appropriation Committee's Subcommittee on Commerce, Justice, State, the Judiciary and Related Agencies, which controls the purse strings for ATP, bluntly stated: "It is my intention to zero out this program." Rogers complained that the Commerce Department had shifted funds within NIST to ATP, thereby ignoring the expressed will of Congress, which has tried to kill ATP for the past two years. He informed Good that he plans to provide ATP only the funds it needs to fulfill whatever obligations it already has with companies, and no more.

Good appeared flushed and angry when Democrats on the subcommittee also showed scant support for the program. Alan B. Mollohan of West Virginia, the panel's ranking minority member, and David Skaggs of Colorado, told Good that Commerce's funding request for 1998 and future years didn't seem to take into account either budget or policy realities and was shortchanging NIST's core research functions.

Even the House Science Committee, which has been the strongest supporter of ATP in Congress, appears to be weakening. An oversight hearing of the Subcommittee on Technology was, at best, ambivalent about the program. The subcommittee is led by Republican Constance A. Morella, whose congressional district in Maryland includes NIST's main campus. At a hearing in April, Morella said the fiscal 1998 budget request is lopsided, because