

course of precipitous decline," said Thomas Donahue (University of Michigan and head of the Space Science Board). He estimated that a lower limit for the overruns would be in excess of \$250 million, out of a total estimated expense of \$700 million. Congress has not acted on the final NASA budget, but the indications are good. Both Houses have added funds specifically to cover cost overruns associated with the Space Telescope.

McDonald was also worried about the impact these delays will have on other programs. For example, the Advanced X-ray Astrophysics Facility was originally planned to be a new start in FY 1986, but is expected to be delayed as a result of problems with the telescope. McDonald explained that these projects were originally planned to be done in sequence and, he said, "It is not possible now to tell how much of a delay or the exact nature of the adjustment that might have to be made to this project." AXAF was the highest priority of the Astronomy Survey Committee of the National Academy of Sciences led by George Field of Harvard (PHYSICS TODAY, April 1982, page 46). Gerry Shannon, who coordinates the Space Science Working Group at the AAO, told us "If AXAF isn't ready to fly by 1990 there will be a real loss of continuity in data, putting stress on the research staff at many universities." The Solar Optical Telescope, now in the early stages of planning, might also be affected.

Space science. The FY 1984 budget request includes only a 3% increase for space science and applications; however, this reflects a growth of 14% in the science budget and an 18% decline in the applications budget. Within the \$514.6 million requested for physics and astronomy, funding for the Gamma Ray Observatory increases a whopping 160% over FY 1983 to \$89.8 million in FY 1984. This project suffered an estimated two-year delay as a result of FY 1982 cuts that brought the funding down to \$5 million. The design should be completed in 1984 and the launch is now scheduled for 1988.

Planetary exploration programs increase 10.2% to \$205.4 million in the FY 1984 request. Among them is the Venus Radar Mapper, a new start in FY 1984 with \$29 million; it is a scaled-down version of the Venus Orbiting Imaging Radar mission authorized by Congress in FY 1982, but eliminated in the FY 1983 request. Hans Mark (Deputy Administrator of NASA) told us the new plans call for only one antenna, which will be used both to collect data over the complete orbit and to transmit it back to earth. Mark estimates the cost of VMR as \$350 million over the next five years, or about half of the estimated cost of

VOIR. To achieve this saving, the atmospheric experiments originally planned for VOIR were dropped and some accuracy was lost, but VMR will still use synthetic aperture radar to penetrate the thick clouds that cover Venus and obtain a 1-km-resolution map of the surface of Venus. The work on developing VMR will be done at the Jet Propulsion Lab; it is now scheduled for launch on the Shuttle/Centaur upper stage in 1988.

The Galileo Mission continues with \$79.5 million in FY 1984, down 13.2% from 1983. The launch vehicle has changed back from the inertial upper stage to the Centaur, which has caused the scheduled launch to slip from 1985 to 1986. However, by using the more powerful Centaur launcher, Galileo is scheduled to arrive at Jupiter in late 1988 instead of in 1990. In addition to orbiting Jupiter and obtaining photographs of its major satellites, the mission will drop a probe into the atmosphere and *in situ* experiments will measure the characteristics of the atmosphere.

The FY 1984 request also provides for initiation of the design and development of the Extreme Ultraviolet Explorer; the EUVE experiment is under the direction of its principal investigator, Stuart Bowyer at Berkeley; work on the spacecraft is now being started at JPL. The International Solar Polar Mission, a joint venture with the European Space Agency, is slated to receive

\$8 million in FY 1984, up from \$6 million appropriated in FY 1983. This is a scaled-down version of the original plan to fly two spacecraft simultaneously over the Sun's poles. The single European spacecraft, carrying some American experiments, is now scheduled for launch in 1986.

While the budget for space transportation systems declines 3% to \$3.49 billion in the FY 1984 request, \$3.3 million is requested for a new Tethered Satellite system. This will be a joint effort by the US and Italy to drag a satellite up to 100 km beneath the Shuttle and conduct experiments in the upper atmosphere.

Data analysis. Funds for tracking and data acquisition increase in FY 1984 to \$700.2 million, including \$200 million to begin paying for a satellite that will replace many tracking stations. Last year's cuts to the tracking budget threatened to silence the Pioneer missions. The 10% cuts to the research and analysis budgets in the FY 1984 request, however, alarmed scientists. Like last year, Congress has increased support for R&A. While still concerned about support for R&A and the final NASA budget, Donahue shared an optimism expressed by others we spoke to in the scientific community—a feeling that within the Administration the climate had changed for research support. He said "I don't believe there will be a repeat of these crazy exercises next year."

—JC

Once again, bad grades for US schools

Challenged by the Soviet Union's Sputniks and confronted by the postwar baby boom, a strong constituency developed in the late 1950s for improving US education, especially in science and mathematics. Local bond issues were voted to build more classrooms, equip more school laboratories and hire more teachers. Colleges and universities ran teacher-training programs. Leading scientists, worried about the poor preparation of students entering their classes, became active in curriculum reform, preparing new textbooks and other teaching materials in efforts supported by the National Science Foundation and Office of Education.

Over the years, however, the commitment to improving the nation's school system has dissipated. Current attitudes about education at every level, said the 18-member National Commission on Excellence in Education in its slim but forceful report, *A Nation at Risk*, released on 25 April, are characterized by "a tension between hope and frustration." With its strong language, the report is admirably uncompromising.

"We report to the American people that while we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people. What was unimaginable a generation ago has begun to occur—others are matching and surpassing our educational attainments," the opening page declares.

"If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves."

Since it was appointed in August 1981 by Terrel H. Bell, Secretary of Education, the commission has gathered a disturbing array of indicators of the nation's educational failings:

► Some 23 million American adults are functionally illiterate by the simplest tests of everyday reading, writing, and comprehension. About 13 percent

of all 17-year-olds can be considered functionally illiterate. Worse, nearly 40 percent cannot draw inferences from written material and as many as 65 percent cannot solve a mathematics problem requiring several steps.

► Scores on standardized tests by high-school students are now lower than 26 years ago when the first sputniks were launched. Average verbal scores on the College Board's Scholastic Aptitude tests plunged more than 50 points in two decades, while math scores fell nearly 40 points. Consistent declines are recorded in physics among 17-year-olds, as measured by the National Assessment of Educational Progress on physical sciences, conducted in 1969, 1973 and 1977.

► Between 1975 and 1980, remedial math courses in public four-year colleges increased by 72 percent and now make up one-quarter of all mathematics courses taught in those institutions.

The inadequacies of US education, the commission finds, are imbedded in four important aspects of the whole schooling process: content, expectations, time and teaching. High-school curricula have been "homogenized, diluted, and diffused to the point that they no longer have a central purpose," says the commission.

By contrast, in many other industrialized countries, courses in mathematics (beyond simple arithmetic), physics, chemistry, biology, and geography usually start in grade 6 and are required of all students. "The time spent in foreign schools on these subjects, based on class hours, is about three times that spent by even the most science-oriented US students—i.e., those who select four years of science and mathematics in secondary school," the report asserts. A 1980 nationwide survey of high-school diploma requirements indicates that 35 states call for only one year of mathematics and 36 require only one year of science. "In many schools, the time spent learning how to cook and drive counts as much toward a high-school diploma as the time spent studying mathematics, English, chemistry, US history, or biology," the report laments.

The commission recognizes a "particularly severe" shortage of science and mathematics teachers almost everywhere. Moreover, half of the newly employed teachers in those subjects (as well as in English) are not qualified to teach them; fewer than one-third of US high schools offer physics taught by qualified instructors.

Admitting after its 18-month study that "there is little mystery about what we believe must be done," the commission recommends that:

► High-school graduation requirements should be strengthened so that, at a minimum, all students seeking a

diploma should achieve a "higher order" of intellectual skills in the so-called "Five New Basics"—meaning four years of English, three years of mathematics, science, social studies, and a semester of computer science.

► Schools, colleges and universities should adopt tougher admission requirements, and standardized achievement tests should be administered at major transition points from one level of schooling to another, as they are in such countries as Britain, France, Germany and Japan.

► Teaching and textbooks (and other learning materials) should be upgraded and updated to make them more rigorous and current. The commission also calls upon university scientists, scholars, and members of professional societies, in collaboration with master teachers, to prepare teaching materials, "as they did in the post-sputnik era."

► Teaching needs to be better rewarded and more respected. Salaries for teachers should be increased, and so should their certification standards.

The report concludes on a note of optimism "... our institutions of higher education have provided the scientists and skilled technicians who helped us transcend the boundaries of our planet. In the last 30 years, the schools have been a major vehicle for expanded social opportunity, and now graduate 75 percent of our young people from high school. Indeed, the proportion of Americans of college age enrolled in higher education is nearly twice that of Japan and far exceeds other nations such as France, West Germany, and the Soviet Union."

Citizens need to hold school officials and elected officials responsible for leading the reforms. Beyond that, the commission calls on the National Academy of Sciences, National Academy of Engineering, NSF, and other scholarly, scientific and learned societies to join the effort.

The commission was headed by David Pierport Gardner, now president of the University of Utah. —IG

Keyworth decries scientists' negative reaction to ABM

While much of his speech at the APS meeting in Baltimore in April restated current policy on Federal support for R&D, George Keyworth (Presidential Science Adviser) took this opportunity to admonish "scientists active in arms reduction" for the "strangely dogmatic" position they have taken in response to President Reagan's "Star Wars" speech. On 23 March Reagan called on the "scientific community in our country, those who gave us nuclear weapons," to make "nuclear weapons impotent and obsolete" by devising a

defense against ballistic missiles. Keyworth was disappointed in the negative reactions that the President's speech has elicited so far. "Some pointed out deficiencies in systems not yet invented. Others declared outright that the task is forever impossible." He said, "I can't believe they're representative of the views of the community. But unless the community—unless you speak up to widen the debate, we may see a potentially world-changing opportunity stifled by a handful of self-appointed spokesmen."

Keyworth told APS that we do not yet know how to accomplish such an ABM defense. But, he made an analogy between the feasibility of ABM technology and the problem of developing fusion as an energy source. "Thirty years ago—or even today—a skeptic could point out a dozen technical reasons why fusion would never be successful." In fact, "after 32 years and billions of dollars I'd be surprised if we were even halfway to our goal," Keyworth said. He asked physicists not to fall "into the familiar trap of using current experience to evaluate tomorrow's knowledge."

Keyworth also voiced concern about the toll international competition has taken on the US lead in scientific research. "Our world leadership in high-energy physics has been dissipated. In the years American physicists squandered on a porkbarrel squabble, the Europeans moved boldly ahead;" it is now "a time for statemanship, not pet projects," Keyworth said, calling for the cooperation of the scientific community to regain US leadership.

Citing his own efforts in this regard, Keyworth said, he was "kidded by the people where I work about the amount of time I spend on high-energy physics problems." According to Keyworth, he has already begun speaking to Congressional leaders about the possibility of building a Desertron. While noting that a \$1 billion to \$5 billion investment for 1000–2000 scientists will be hard to sell to Congress, he nonetheless felt that "a 20-TeV accelerator should be taken extremely seriously." Such a machine would allow the US to go beyond LEP at CERN, scheduled to collide 50-GeV electrons and 50-GeV positrons when it comes on line in 1987 (and eventually 130 GeV in each beam) and, the recently approved HERA (proposed for construction at DESY), which would collide 820-GeV protons with 30-GeV electrons. Nonetheless, Keyworth described the HEPAP meeting in Woods Hole in June, as a "watershed episode" for high-energy physics and cautioned physicists about assuming that taxpayers would bear the expense of new accelerators without clear enunciation of priorities from the scientific community. □