

belief."

In other decisions, such as the Alabama case, the Court expressed its trouble with Jefferson's aphorism using such terms as "blurred," "indistinct" and "incomplete." In his dissent, Associate Justice William H. Rehnquist called for abandoning Jefferson's "misleading metaphor." It is these latest rulings as well as the current makeup of the Court, with Rehnquist now Chief Justice, that make *Edwards v. Aguillard* so crucial. The decision could affect the intense national debate over the place of religion in society, including the way public schools and textbooks deal with scientific knowledge, processes and emerging issues.

The strategy used by creationists in the Louisiana act, which the state legislature passed by a large majority, sought to avoid "the inescapable religiosity" that had been exposed in other actions that have come before the courts. Because the Supreme Court may decide whether creationism is science, many scientists have entered the fray with *amicus curiae* briefs. In one such brief, the National Academy of Sciences declared that creationists place themselves beyond reach by asserting that creation "requires the direct involvement of a supernatural intelligence and thus cannot be directly tested by scientific method." To this assertion the academy retorted, "If no test can be conceived that could prove a proposition wrong, it is not a proposition of science."

Nobelists. Among the other 15 *amicus curiae* briefs, most coming from scientific and educational groups, is one filed by 72 Nobel laureates and 17 state academies of science. The organizer was Caltech's Murray Gell-Mann, who began gathering support after the Supreme Court decided to take the case last spring. According to Gell-Mann, Louisiana's concept of creation science is essentially religious beliefs promoted as pseudoscientific doctrine. At a news conference last August in Washington, held to coincide with the filing of the Nobelists' brief, Stephen Jay Gould, a paleontologist at Harvard University, called creation science an oxymoron—"a self-contradictory and meaningless phrase, a whitewash for a specific, particular and minority religious view in America: Biblical literalism."

When the case reached the Supreme Court for an hour of oral arguments, Wendell R. Bird, attorney for the state, conceded that while "some legislators had a desire to teach religious doctrine in the classroom," the purpose of the Louisiana law was "primarily secular." Responding to Associate Justice Sandra Day O'Connor's question whether

National Academy: Creationism is religion, not science

"Scientists, like many others, are touched with awe at the order and complexity of nature. Religion provides one way for human beings to be comfortable with these marvels. However, the goal of science is to seek naturalistic explanations for phenomena—and the origins of life, the Earth and the universe are, to scientists, such phenomena—within the framework of natural laws and principles and the operational rule of testability.

"It is, therefore, our unequivocal conclusion that creationism, with its account of the origin of life by supernatural means, is not science. It subordinates evidence to statements based on authority and revelation. Its documentation is almost entirely limited to the special publications of its advocates. And its central hypothesis is not subject to change in light of new data or demonstration of error. Moreover, when the evidence for creationism has been subjected to the tests of the scientific method, it has been found invalid.

"No body of beliefs that has its origin in doctrinal material rather than scientific observation should be admissible as science in any science course. Incorporating the teaching of such doctrines into a science curriculum stifles the development of critical thinking patterns in the developing mind and seriously compromises the best interests of public education. This could eventually hamper the advancement of science and technology as students take their places as leaders of future generations."

—*Science and Creationism: A View from the National Academy of Sciences.*
NAS Committee on Science and Creationism,
James D. Ebert, Chairman, 1984

it is valid to teach religious belief in order to balance nonreligious teaching, Bird acknowledged that "teaching religious doctrine is unconstitutional." The Louisiana statute, he added, does not call for religious instruction but for balancing the teaching of evolution by exposing students to "scientific evidences supporting creation" and to scientific doubts about evolution. This would include discussion of the "mathematical improbability" that life forms in their riotous diversity could have evolved from one-celled organisms over billions of years.

Associate Justice Antonin Scalia, the newest appointee to the Court, challenged many of the arguments put forward by Jay Topkis, representing the American Civil Liberties Union, which opposes the act. Could the Big

Bang be considered an act of theistic creation, Scalia asked, with evolution following afterward? "What about Aristotle's idea of a first cause—an unmoved mover? Would that be a creationist view? Would that make Aristotelian philosophy a religion?" posed Justice Scalia. Topkis said it would not and parried with references to St. Thomas Aquinas and Baruch Spinoza, but stressed that such concepts were not the moving force of the Louisiana law, which had little to do with philosophical subtleties or secular purposes. For instance, said Topkis, what the act's advocates mean by academic freedom is, "simply put, 'We've got to give God equal time.'"

The Court is expected to hand down a ruling by July.

—IRWIN GOODWIN

Education

NSF undergrad programs upset scientists

Among the most dismaying accusations in *College—The Undergraduate Experience in America*, a critical examination of baccalaureate education published last November (Harper and Row), are that students remain unchallenged intellectually and that their major specialties lack enrichment. The report, written by Ernest L. Boyer, president of The Carnegie Foundation for the Advancement of Teaching, and based on studies of students, faculty and administrators at 29 public and private four-year schools in various parts of the country, is still another low grade for American academe.

Until recently all the bad marks were given in the pre-college years. The Carnegie report on colleges can be

read as a cheerless companion to its earlier study, *High School*, and to an even more sobering inquiry of pre-college schooling, *A Nation at Risk*, in which the National Commission on Excellence in Education cited a "rising tide of mediocrity that threatens our very future as a nation and a people" (PHYSICS TODAY, June 1983, page 44).

The outpouring of reports carrying more or less the same message is contributing to a wave of school reforms now sweeping through state legislatures and local school boards. Teacher pay scales are going up, often on the basis of merit reviews, and student graduation standards are being raised to meet the demands of concerned parents and prospective em-

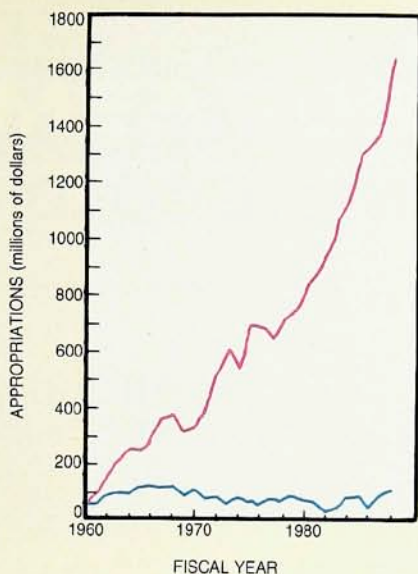
players.

Deficiencies. But the situation in undergraduate education does not appear so promising, especially in mathematics, engineering and the sciences, where "serious deficiencies" exist, a task force of the National Science Board concluded last year (PHYSICS TODAY, June, page 65). The Science Board panel, under the chairmanship of Homer A. Neal of the State University of New York at Stony Brook, spoke up sharply about the declining content and quality of science, mathematics and engineering programs in the nation's undergraduate schools and urged the National Science Foundation to put much more money into laboratory instruments, curriculum development, teacher training and undergraduate participation in research. During the board's discussions of the report with the foundation's director, Erich Bloch, several prominent members demanded that the agency get on with it with all due speed.

This position was reemphasized by another entreaty last November from NSF's Advisory Committee for Science and Engineering Education, which is headed by Gerald Holton of Harvard University. At its November meeting the committee applauded Congress for increasing NSF's science and engineering education budget by \$12 million this year—\$10 million more than the foundation had originally requested—over the \$87 million the agency had in fiscal 1986. "Even so," says Holton, "the foundation's budget for science education this year equals the cost of one cup of coffee per year for every American."

Disparity. Committee members went on to voice their dismay with NSF's lack of commitment to the 1950 organic act that set out the agency's function, which stipulated that support of science education at all levels was to be roughly comparable to funding of scientific research. The disparity between education and research has widened over the years (see graph). Indeed, the record in NSF's early years indicates that the education budgets ranged from more than one-half to about one-third of the total research program's. Since fiscal 1970, however, education funding has dwindled, and by 1982 it was less than 2% of NSF's research operations. Virtually all the 1982 education budget was devoted to graduate fellowships.

At that low point Congress charged in. Commenting on the process by which Congress has raised NSF's budget for education the past few years, Holton voiced concern that there is a price the foundation may have to pay down the line: "It invites further legislative involvement in the setting of



NSF appropriations for science and engineering education (blue) and for research and related activities (red).

priorities and it creates a strong temptation to lobby Congress on behalf of NSF's education program."

As it is, some prominent members of Congress are displaying frustration over NSF education budgets submitted by the Reagan Administration. At a hearing on the agency's 1987 budget before a House Appropriations subcommittee last year, Representative Edward P. Boland, a Massachusetts Democrat, showed impatience with Bloch's replies to questions about getting "the most bang for the buck" by increasing the account for teacher preparation while reducing research dollars. Boland accused Bloch of putting forth a budget in which education "brings up the rear in your priorities."

Valedictory. Other Congressmen were equally plainspoken. Before retiring from Congress last December, Don Fuqua, who represented Florida's Second Congressional District for 12 terms, issued his personal observations on science policy matters from his vantage as chairman of the House Science and Technology Committee. In his valedictory, Fuqua reproached the "essentially monotonically decreasing fraction of the NSF budget" for science education. "Recently there has been a stirring of educational activity in the NSF, but in the harsh competition for funding, the research component will be totally dominant under any conceivable scenario. Even with concerted effort, things are not likely to improve much. The problem is far too deeply rooted," Fuqua wrote. "It's time to think the unthinkable!"

Though he once believed that science education could be managed best by

NSF, in keeping with the agency's original mandate from Congress, Fuqua reluctantly came to the conclusion, based on the pattern of funding over several administrations and the "second-class status" of the education directorate within the agency, that education "is better handled by educators than by research scientists." Using uncharacteristically pungent language Fuqua claimed that science education within NSF is guided by the "ravenous mavins of research."

Accordingly, he proposed that this function should be turned over to the Department of Education, which "could provide a responsible, caring, knowledgeable environment away from some of the unrealistic and elitist approaches provided by some of the nation's top scientists funded in this endeavor by the NSF." However, if the responsibility is to remain with NSF, Fuqua asserted, "at the very least a plan should be initiated to raise the funds devoted to science education to the neighborhood of 10% of the NSF budget."

Anomalies. A panel of the Holton advisory committee, headed by George C. Pimentel, a chemist at the University of California in Berkeley, also looked at the agency's funding anomalies and concluded that Congress's reaction "permits the interpretation that NSF does not have an adequately strong commitment to the nation's needs for better science and engineering education [which] must be unambiguously recognized, preserved and enhanced" at all schooling levels. Pimentel's panel found that the recommendations of the Neal task force to back undergraduate education with \$42 million in fiscal 1988 and \$92 million in 1989 are likely to be unacceptable to this Administration.

Looking at the ways that NSF management intends to fund science, mathematics and engineering education, the advisory group expressed disquiet that a new project called "Research experiences for undergraduates" has been placed in the research directorates rather than the science and engineering directorate, which the Neal panel recommended as the focal point for such activities. The program will provide \$9 million to colleges and universities, as well as such nonacademic research centers as government or industrial labs, to introduce some 2000 undergraduates to the wonders of research. "It's an excellent way of providing research experiences for undergraduates," says Holton, "but we would like to see this program, like all its predecessors, in the education directorate, its logical home."

—IRWIN GOODWIN □