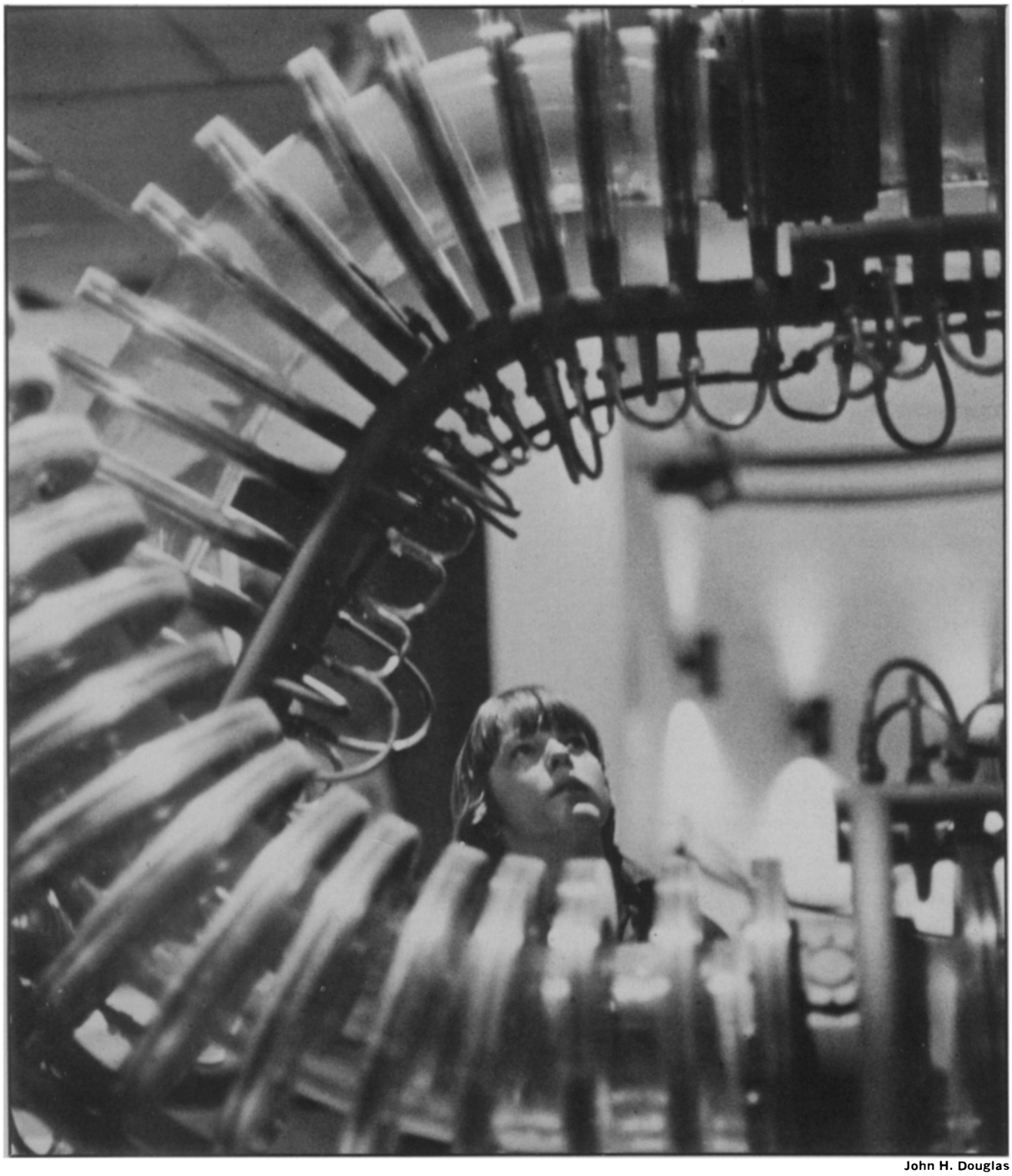
A DOUBLE-BARRELED CHALLENGE FOR SCIENCE EDUCATION

The energy crisis focuses new attention on the need for scientists and a greater public understanding of science. NSF has a new chief for education. But will the money come too little, too late?



John H. Douglas

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *Science News*. www.jstor.org

by John H. Douglas

"The society which scorns excellence in plumbing because plumbing is a humble activity and tolerates shoddiness in philosophy because it is an exalted activity will have neither good plumbing nor good philosophy. Neither its pipes nor its theories will hold water."

—John W. Gardner

Science is part plumbing and part philosophy, and the teaching of science reflects, in large measure, the emphasis society wishes to have placed on one or the other of these aspects. First with Sputnik and now during the energy crisis, society has clamored for more scientists and engineers trained to produce the technology needed to escape from the crisis—that is, better "plumbing." At the same time, however, students have grown more skeptical of what they see as shoddy "philosophy" behind this movement—that just *more* technology and *more* scientific research will automatically secure the desired productivity and social benefits.

Science education may finally have progressed to the point that a balanced program is possible, offering top-quality technical preparation for the budding science professional, while providing a broad enough understanding of the technical world to the nonscientist that he can better adjust to the rapid changes surrounding him and act responsibly on issues arising from these changes. But the question remains whether society and the present Administration will adequately support science education enough to provide both professional training and understanding for the citizen.

Finding eager students should pose no problem. While rising social consciousness has led to scattered instances of antitechnology outbursts, exemplified by the graffito "Science kills" scrawled in black spray paint on the AEC building in Berkeley, Calif., more often it has resulted in the desire to apply science and technology to humanitarian aims. This eagerness is usually cited, for example, as one cause of rapidly increased medical school applications, which reached a 20-to-1 ratio with admissions in some leading schools this year. Opportunities for women and minorities to enter technical fields are also increasing, partly through "affirmative action" programs and partly from a natural shedding of old stereotypes throughout society.

Science education's chief Federal funding agency, the National Science Foundation, is also encouraging a two-pronged approach: what it calls "education for careers in science" and "science literacy." Beginning in 1971, the NSF has been redirecting its programs toward developing new approaches in science curricula, intended to attract more nonscience majors, while simultaneously shifting grants and traineeships so as to shepherd budding science professionals into areas of greatest social need. But educational costs are rising faster than any segment of the economy except medical expenses, and the Office of Management and Budget began impounding and redirecting appropriated funds, causing the resignation, in protest, of NSF's assistant director for education. Budget requests for NSF diminished, advocacy from the President's Office of Science and Technology was lost from the White House and, for a long time, no permanent replacement for the resigned assistant director was appointed.

Conflict with Congress came to a climax of sorts last March 1 during House hearings on the NSF fiscal 1974 budget. During a heated exchange with the acting assistant director for education, Keith R. Kelson, the hearing's chairman, Rep. John W. Davis (D–Ga.), quoted a 1968 statement by the then Presidential candidate Richard Nixon, saying: "The decline of science education is the most damaging indictment of present administration policy. It threatens to cripple the national efforts in science for years to come." Davis then noted that under the present Administration, funds for science-education improvement and graduate student support had been cut in half from their 1968 level.

Kelson replied that after a lot of "very hard thinking," the Administration had decided that the appropriate role for NSF was not to sustain national programs in science education, but rather to lead in the innovation of new ones. After this initial "seeding," other agencies would be better at sustaining long-range application. NSF Deputy Director Raymond L. Bisplinghof suggested that HEW would be a good agency for the role, but under further questioning admitted that parents of college students might eventually be the sustainers of established programs, through higher tuition.

Then came the energy crisis, and a new urgency was added to talk about science education. Mathematician Lowell Paige accepted the task of filling the uneasy position of NSF assistant director for education. In a recent interview with SCIENCE NEWS, Paige explained the latest planning for science education, and displayed a modesty pointedly uncharacteristic of Washington bureaucrats. "I don't know if this is possible," he repeated on several occasions, "but all we can do is try."

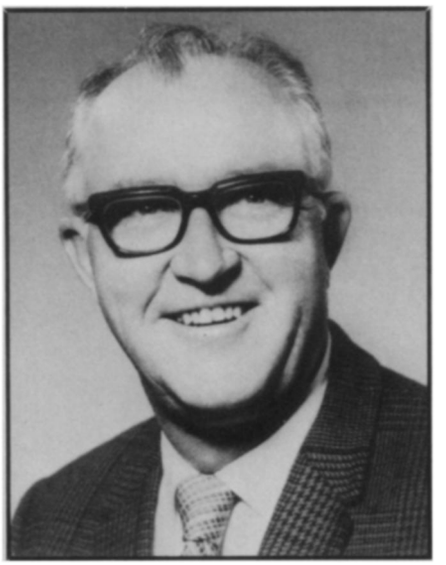
Saddled with a fiscal 1975 science education budget some six and a half million dollars below last year's, NSF is nevertheless trying to solidify past achievements in curriculum development and student support, while breaking new ground in the previously overlooked areas of continuing education and technician training. At the high school level, where a plethora of new curricula have become available, Paige says summer programs for teachers will begin to concentrate more directly on how the new courses can be introduced into the classroom, rather than concentrating on updating the teachers' own knowledge of the subject matter, as in past summer institutes. Separate programs for administrators will emphasize evaluation of the various courses so that only those most appropriate will be purchased for a school system.

Junior colleges, which now represent the fastest growing segment of the educational enterprise, are expected to play a larger role in training the lower eche-

lons of science professionals, offering technician training that will give a two-year graduate employable skills, as well as a foundation for a further academic career. Such training, Paige says, should particularly help the "stop out" student, who would thus be better able to find profitable technical employment to pay for later education, while learning specific skills that could be helpful when he returns to school.

Limited funds will again plague efforts to give broad support to science students in four-year colleges and graduate school, but Paige is hopeful about some new programs in these areas. NSF is helping fund a few locally initiated projects aimed at restructuring undergraduate science curricula around interdisciplinary lines, with more emphasis on problem solving as opposed to role learning. NSF's traditional graduate traineeships will continue to be phased out, but 150 new, narrowly directed traineeships will be added, to support three-year graduate programs in solar energy, geothermal energy and coal research. Next year, postdoctoral fellowships in energy research may also be added. In the meantime, Paige says he would like to raise the number of NSF fellowships for graduate students, but adds rather wistfully, "I haven't yet found an argument to convince the Administration."

As the flood of new scientific knowledge increases, so does the need for "mid-career" continuing education. An official of one of the nation's largest chemical companies has estimated that skills in his area become obsolete in only seven years—less time than it took to gain those skills in the first place—and that a professional chemist must somehow reeducate himself within that time. In industry, part of this retraining is sponsored by the companies involved, either through in-house programs or through subsidized schooling. But for technical workers suddenly out of a job, for lower level scientific workers seeking to better their positions or for the million and a half elementary school teachers who find their limited knowledge of science quickly falling behind the times, few specifically tailored programs—and less financial help—exist to encourage reeducation. Paige freely admits "we won't be able to solve this by ourselves," but he is hopeful that a cooperative effort between NSF and other agencies, can begin to attack the problem, perhaps with further input from revenue sharing and teacher's unions. Paige has asked for new proposals on continuing education from his technical advisory committee. Some model programs, like one near Irvine, Calif., incorporating television courses for engineers, have already been approved.



NSF

Paige: . . . But all we can do is try.

Science "literacy" will be encouraged by NSF through sponsorship of alternative degrees that emphasize interdisciplinary studies directed toward specific technical problems. At UCLA, for example, a doctoral program in environmental studies has been instituted, with the traditional thesis requirement replaced by an internship program calculated to bring the student into direct contact with the practical problems he will encounter during his professional life.

NSF will also experiment with new programs to encourage more women and members of minority groups to enter scientific careers. New science-oriented traineeships are scheduled for master's level work at some black colleges, but Paige feels that minority programs should aim at the high-school level, identifying and encouraging talented students before they get to college. The problem with women, he says, is completely different. Many girls take high-school science courses and do exceptionally well, only to opt-out of science altogether in college. Only 0.7 percent of entering college freshmen women, for example, choose engineering, compared with 9.4 percent of the men. More research is needed into the social barriers that apparently inhibit women from choosing these careers, Paige says, adding that some promising signs of the disappearance of sexual barriers can already be seen in some fields, especially biochemistry.

Already the changes in science education and student attitudes toward science are being felt by communities. By addressing themselves toward the solution of real problems, students are brought into contact with the political as well as technological realities of society. High-school students in Idaho, for example, studied traffic flow patterns of two one-way streets in their community, and eventually convinced town fathers to alter the routes. When Huntsville, Ala., had to submit an environmental impact statement concerning a proposed waste disposal facility, planners found that most of the necessary information had already been collected by some college students working under a Student-Oriented Studies grant from NSF.

Several Government agencies are beginning to cooperate in making new technologies available to teachers. NSF continues to sponsor computer assisted instruction projects, but is becoming increasingly concerned with making cost-effectiveness evaluations to see what is the potential for such systems to enter the educational mainstream. NASA and the National Institute of Education are jointly sponsoring an educational satellite project to provide continuing education for teachers in Appalachia, audiovisual materials to students in the Rocky Mountain region and prereading instruction and basic health information for Eskimo children in Alaska.

The problems of science education, however, cannot be separated from those of education in general, nor from the greater, encompassing problems of society as a whole.

Addressing himself to the relationship of science education to these larger problems, Philip H. Abelson, president of the Carnegie Institution of Washington and editor of SCIENCE magazine, wrote in the New York Times: "America's greatest weakness at present lies in her inability to mesh her political institutions with technological facts of life. . . . Our political system is poorly equipped to deal with long-term, undramatic problems." The key to presenting those facts of life to society, he continues, is, science education. The energy crisis, for example, cannot be solved without having both more scientists and engineers trained in the relevant technical areas and an informed public capable of understanding the options and constraints from which they must ultimately choose.

Science education is at a crossroads. National Academy of Sciences President Philip Handler foresees a shortage of scientists in the near future. Yet for the first time ever, the enrollment in America's elementary schools dropped in absolute numbers last year. Colleges in the United States have an estimated 500,000 vacancies, yet teachers are being produced at almost twice the rate than they can be employed. What remains to be seen is whether this surplus potential can be channeled to meet the educational deficits of continuing education, science literacy and the need for technical manpower. □