

## NSF: How Much Responsibility for Course Content, Implementation?

As a result of congressional criticism of the National Science Foundation's curriculum development program, NSF is under pressure to assume greater responsibility for the content of courses developed with federal funds. NSF has always avoided endorsing the new courses lest such endorsement be interpreted as federal dictation of curriculum, but now the foundation could find itself in the awkward position of being damned if it does and damned if it doesn't.

The NSF education programs have been under heavy scrutiny this year, particularly in the House of Representatives; but attention has centered mainly on NSF's peer review system (*Science*, 8 and 15 August), and the legislators have been diverted somewhat from the issue which originally attracted the critics in the House—the content of new social science courses for elementary and secondary school students.

Now, Representative Olin E. Teague (D-Tex.), chairman of the Science and Technology Committee which wields legislative authority over NSF, has released two reports which serve to refocus the discussion on the question of NSF responsibility for the content of courses developed with its support.

The two reports, one from the General Accounting Office (GAO) and the other from a "science curriculum implementation review group" (chaired by Texas Christian University chancellor J. M. Moudy) appointed by Teague when the benefit of outside opinion seemed called for, concentrate on a behavioral science course designed for fifth graders called *Man: A Course of Study* (MACOS) (*Science*, 2 May 1975).

This was the course singled out by Representative John B. Conlan (R-Ariz.) for harsh criticism in remarks on the House floor during debate on the NSF authorization bill on 9 April, and it has been a constant point of reference in a campaign that has made Conlan the chief critic of the NSF curriculum development effort.

In his attack on MACOS on the House floor Conlan concentrated on the portion of the course which deals with a subculture of the small group of Netsilik Eskimos in the Pelly Bay region of Canada, noting that "Student materials have repeated references in stories about Netsilik cannibalism, adultery, bestiality, female in-

fanticide, incest, wife-swapping, killing old people, and other shocking practices." He also criticized the use of federal funds for the promotion of social studies materials in competition with regular commercial textbook publishers, but informed observers say that it was Conlan's vivid depiction of the contents of MACOS which influenced the House to vote an amendment to the NSF authorization bill that would have required NSF to send all research grants to Congress for review. This provision, contained in an amendment offered by Representative Robert Bauman (R-Md.), was later dropped in House-Senate conference, but there is no doubt that Conlan succeeded in making an issue of MACOS.

### Tapping Public Resentment

While, in terms of legislative power, Conlan and his allies appear to muster hardly more than a corporal's guard in the House, there is little doubt that he tapped significant reserves of public resentment with his remarks on MACOS.

The objections to MACOS seem to be at least partly inspired by the sort of sentiments which spurred citizen groups in Charleston, West Virginia, in the past year, to protest the inclusion of what they regarded as "dirty books" in school reading lists, in at least one case resorting to a bombing to make their point. There is nothing new about opposition to the open treatment of sex or the teaching of evolution theory in the schools, particularly in the so-called Bible Belt, but the recent protests appear to be based on a broader argument. The complaint has been that teaching undercuts religious training, parental authority, and respect for government and law. And the blame seems to be allotted to the federal authorities as well as local school officials, perhaps because of resentment over such things as the court ban on Bible reading in the schools and court-ordered busing.

Conlan, who hails from Phoenix, literally and figuratively represents an area noted for its social and political conservatism. Arizona Republicans tend to be staunch in their opposition to federal social and economic programs and highly suspicious of any federal initiative in education. Social and behavioral scientists also seem to be regarded with suspicion on the old frontier,

particularly when they come from elitist eastern institutions. Psychologist Jerome Bruner of Harvard and now at Oxford, an expert in child development, had a major hand in designing MACOS, and the MACOS teachers' guide carried some quotes from Harvard's B. F. Skinner; Conlan, in some of his comments on MACOS, strongly suggested that the developers of the course were bent on behavior modification.

The alliance of Bruner and NSF might have given a big opening to someone with the rhetorical style of a Governor George Wallace, who has talked scathingly of intellectuals and pointy-headed bureaucrats, but Conlan, who is highly articulate and reportedly an effective platform speaker, tends to be more lawyerlike in his argument. Conlan, like many Arizonians, was born and educated elsewhere. A native of Oak Park, Illinois, he is a product of Northwestern University and Harvard law school, was a Fulbright scholar at Cologne, and studied for a time at the Hague Academy of International Law. He was elected to Congress in 1972 and is said to be inclined to run for the Senate in 1976 if the Republican incumbent, Senator Paul J. Fannin, decides not to stand for reelection.

Conlan's interest in MACOS dates from the late 1960's, when he was a state senator and schools in a district adjoining his own were engaged in pilot testing of the course. When Conlan reached Congress and joined the committee which oversees NSF, he remembered that MACOS had run into controversy and began to pursue the matter. Conlan's press assistant, George H. Archibald, had written on the subject when he was a Phoenix newspaperman and has kept digging away, so that Conlan is unusually well informed about NSF operations, particularly in the education directorate.

What Conlan espouses is a view which, though not necessarily sectional, is particularly strong in an area extending from Texas to Southern California. The viewpoint is expressed in a pure form in a minority report by the single dissenting member of the Moudy group, Mrs. Joanne McAuley of Dallas, whose major conclusion is that "There is no need for Federal Government intervention in the development and marketing of textbooks and other course curriculum."

Against this background, it might appear that Teague, who represents a district that touches the southern suburbs of Dallas, could be disposed by attitude or circumstances to give NSF a hard time, but it seems generally agreed that his handling of the row over MACOS has been evenhanded and certainly not precipitous. He asked for the GAO report in March and formed the review group after the Bauman

amendment incident. His appointments to the review group reflected his ties to Texas, the space program, and Congress, but observers with no particular axes to grind seem to agree that the group did take a comprehensive look at the situation and produced a constructive report.

In a press statement accompanying the release of the reports, Teague said, "We will review both reports carefully. Where corrective measures are recommended, we will take them seriously. If we agree, then every possible effort will be made by the Committee to see that appropriate changes are made."

In addition to the reports from GAO and the advisory group, plus the McAuley

addenda, the committee has on hand an earlier in-house review by NSF on the agency's pre-college science curriculum activities for comparison and contrast.\*

By and large the GAO and NSF staff reports are compatible. The GAO recommends a series of actions to strengthen NSF procedures governing the choosing of curriculum developers, of selecting peer reviewers, and other aspects of the curricu-

\*The GAO report may be obtained from the General Accounting Office. The title is *Administration of the Science Education Project "Man: A Course of Study" (MACOS)*, Report No. MWD-76-26. The Moudy report is available from the House Committee on Science and Technology. A report by an NSF study team entitled *Pre-College Science Curriculum Activities of the National Science Foundation* may be obtained from NSF.

lum development cycle. With most of these suggestions, NSF seems ready to comply. But there are some questions. GAO sees the need for NSF to establish procedures to safeguard human subjects involved in its educational activities. This raises the question of whether guidelines appropriate for the protection of human subjects in research can and should be applied to students involved in curriculum projects. In a comment appended to the GAO report, an NSF official notes that Department of Health, Education, and Welfare officials advised NSF that the guidelines were not intended to apply to curriculum development projects, so the question seems to be left dangling.

## Chemistry—A Means to Simpler Uranium Enrichment?

A competition has been going on for some time among three scientific groups to find a commercially viable method for producing enriched uranium-235, the fuel of today's light water nuclear reactors and a key element in the manufacture of nuclear weapons. Two government-supported teams are working at Lawrence Livermore Laboratory in California and at Los Alamos Scientific Laboratory in New Mexico (LASL); the third is an industrial group, fielded by Exxon Nuclear Corporation in collaboration with Avco-Everett Research Laboratories of Everett, Massachusetts. All three groups are studying the process of laser isotope separation, which is viewed as the most promising commercial alternative to today's expensive enrichment methods (*Science*, 16 August 1974).

But now, a team not previously viewed as a major player in the game, consisting of two physical chemists at Columbia University, may have solved an important part of the problem. They report finding a simple chemical means of generating uranium vapor—which is the first major step in the laser separation process and the one that has posed the greatest difficulty to scientists. The method, as described by a graduate student, Henry U. Lee, and a professor, Richard N. Zare, in a paper recently accepted for publication in the *Journal of Chemical Physics*, involves what Zare calls "cookbook chemistry" and is the first known, unclassified demonstration of its kind.

Zare says that the method could possibly be commercially viable on a large scale. It is technically simpler than present, oven-heating methods for generating uranium vapor. Hence the development is a major step in the competition to find a workable laser enrichment process.

If this technique, or some comparable chemical method, lives up to its promise, it could make reactors using enriched uranium fuel more economically attractive both in this country and elsewhere in the world. However, since enriched uranium is also the key to building atomic weapons, the technique possibly could facilitate the spread of these to other nations of the world as well.

The Lee-Zare method uses uranocene, a volatile compound known mainly to scientific researchers. Made from uranium tetrachloride, the compound consists of uranium linked to two "plates" of cyclooctatetraenyl (COT). When heated to temperatures of 460°K and made to collide with metastable

argon gas, the uranocene breaks down into unwanted COT, possibly some carbon, and into free uranium atoms; the uranium atoms are separated by laser into the fissionable isotope  $^{235}\text{U}$  from  $^{238}\text{U}$ .

Other methods of generating uranium vapor are technically clumsy and more expensive. At Lawrence Livermore, for example, natural uranium has been heated to temperatures of 2300° to 2700°K in cylindrical tungsten ovens. The cost of heating the ovens to these temperatures is enormous; moreover at those temperatures, well past the melting point of steel, the uranium becomes highly corrosive and eats away at the ovens so that they have to be closed down and rebuilt, according to one knowledgeable source, sometimes as often as every 3 hours. Using this process on a large scale and making it reliable enough for power plant fuel manufacture seems unlikely, according to scientists at a number of institutions who are familiar with the problem.

Nonetheless, Lee and Zare are cautious about these particular experiments, and emphasize that some other uranium compound, or some other chemical process, may prove to be the ultimate answer. But Reed Jensen of LASL, which has been examining "uranium compounds in the same class as uranocene" in what could be a similar manner, says, "It's clear that this is a very imaginative and inventive contribution to the problem."

Large-scale uranium enrichment in the United States is now performed in gaseous diffusion plants, which recirculate uranium hexafluoride many, many times until the desired degree of separation of  $^{235}\text{U}$  is achieved. The plants are estimated at today's prices to cost \$2 billion to \$3 billion. In addition, the facilities for generating the 2000 megawatts of power needed to operate the plant would cost another \$1 billion.

The United States has had a virtual monopoly on the manufacture and distribution of enriched uranium fuel for the last 30 years, thanks to its possession of gaseous diffusion technology. A successor to this technique, the gas centrifuge process, is now being developed in Western Europe, the Soviet Union, and Japan, and may be developed in the United States as well. But the work, at Columbia and elsewhere, linking chemistry to the laser process, is moving enrichment technology steadily in the direction of cheaper, simpler techniques.

—DEBORAH SHAPLEY

The recommendations of the Moudy group† are rather lengthy, but they touch on most of the issues with which NSF will have to come to grips, and those that deal with general policy on curriculum development rather than with administrative matters relating specifically to MACOS are worth quoting in full:

I. With regard to course development and implementation, the Review Group recommends that the NSF continue pre-college science curriculum activities<sup>1</sup> with the following changes in understandings and procedures:

A. Recognition that the NSF and the Congress cannot avoid responsibility<sup>2</sup> for both quality and content of curricula that are federally funded through NSF.

B. Creation of an ongoing needs assessment program that will guide future NSF science curriculum activities.

C. Addition of representative parents to curriculum reviewing and evaluating groups during curriculum pilot-testing periods and all subsequent periods of federal funding, especially in the case of social science curricula.

D. Development of and adherence to complete and clearer policies in all NSF curriculum efforts, including but not confined to: (1) closer monitoring by staff; (2) better evaluation by staff and outside groups; (3) time schedules for support and subsequent phase-out of each NSF implementation effort; (4) consistent and no-favoritism policies covering curriculum promotion, marketing, and publication; and (5) avoidance, in implementation activities, of undue influence, direct or indirect, over local decisions on curriculum adoption.

E. Formal adoption by NSF of acknowledgment and disclaimer statements, and enforcement of same.

F. Establishment of a clear Congressional policy on all royalty income and its disposition.

<sup>1</sup>The review group was not unanimous on this point. Two members felt that the NSF should confine its curriculum work to the natural sciences and mathematics, leaving the social sciences to others. One member felt the NSF should stay out of curriculum entirely.

<sup>2</sup>Just how Congress should exercise its responsibility is discussed later. See also Addendum.

A primary thrust of the recommendations of the Moudy group is that NSF should assume greater responsibility for both the quality and content of the courses funded by the government.

For nearly two decades the foundation has followed policies which resolutely skirted this issue. When the first curriculum development projects were launched in the middle 1950's, it was in an atmosphere fraught with fears that the projects would lead to centralized federal control of curricula. To forestall the critics, NSF treated curriculum development projects as much like research grants as possible. That is, NSF sought good proposals from good people and then provided them considerable freedom to develop their ideas. The agency monitored the materials for

scientific accuracy but made it clear that the completed courses were not recommended by NSF and argued that choices of curriculum were entirely the responsibility of local school authorities.

NSF officials did recognize that they were intervening in the marketplace and tried to develop procedures which were fair and satisfactory to commercial publishers. At the same time, pressure was applied by Congress on NSF to make sure that the expensive and innovative programs did not stay on the shelf. As a consequence, NSF has spent considerable amounts of money on "implementation" programs, designed to provide information and teacher training course materials without crossing the line into subsidizing the adoption of federally sponsored courses.

It would be unrealistic to believe that NSF disclaimers were taken at absolute value and federal support did not give the federally sponsored courses some prestige, but NSF managed to walk a rather narrow line fairly successfully. The strategy worked best during the time when NSF was underwriting mathematics and science courses. Although there were skirmishes about sex education and evolution in the life science curriculum, the new courses won wide acceptance.

New stresses might have been anticipated when NSF moved on to support of curriculum projects in the social and behavioral sciences in the middle 1960's, but NSF rather stolidly plodded on, assuming that the same formula of limited responsibility would work. The impact of a course like MACOS, which uses a multimedia mix of ethnographic films, filmstrips, tapes, role-playing "games," and other innovative approaches, could appear to the outsider to be heavy on sex and violence, particularly if the material is presented selectively. Then there were fair questions raised about whether there could be any assurance that the course would always be taught by teachers properly trained and competent to handle it and even whether some of the material was really suitable for all 10-year-olds.

Now there will obviously be pressure on NSF to develop a means for reviewing the content of its courses. The House Appropriations Committee has already demanded that NSF develop a clear statement of national needs in the curriculum field to guide its program, and also make a substantive review of the new courses under development before they are implemented. The foundation is moving to oblige, but there is reluctance to shift from affirming the scientific accuracy of material to certifying the educational value, as GAO suggests, or to applying some general seal of approval.

NSF has up to now shunned giving such approval because it would be surely interpreted as a federal endorsement of a course, something that would horrify the original critics of the NSF who feared federal intervention.

So NSF is faced with a kind of Catch-22 on course content and is likely to be asked to make more than minor administrative and management changes. A lot of time and effort have been spent in telling NSF it is accountable; now Congress and the foundation have to work out how.

—JOHN WALSH

## APPOINTMENTS

**Alan A. Johnson**, chairman, department of materials science and engineering, Washington State University, to dean, Graduate School, University of Louisville. . . . **Nick L. Lund**, acting chairman, psychology department, University of North Florida, to chairman at the university. . . . **Venkat N. Reddy**, assistant director of the Institute for Biological Sciences, Oakland University, to director, at the university. . . . **Lloyd Guth**, National Institutes of Health, neuronal development and regeneration, to chairman, department of anatomy, School of Medicine, University of Maryland. . . . **Robert Dickes**, professor, psychiatry, Downstate Medical Center, State University of New York, to chairman, department of psychiatry, at the center. . . . **Vincent Lanzoni**, associate dean, medical school, Boston University, to dean, College of Medicine and Dentistry of New Jersey, New Jersey Medical School. . . . **Michael Sela**, head, Weizmann Institute's chemical immunology department, to president of the institute. . . . **Ellis B. Page**, University of Connecticut, Storrs, to president-elect, division of educational psychology, American Psychological Association. . . . **William H. J. Douglas**, associate scientist, W. Alton Jones Cell Science Center, to associate director, education, at the center. . . . **Thomas A. Gonda**, medical director, Stanford University Hospital and Clinics, to chairman, psychiatry and behavioral sciences department at the school.

*Erratum:* In a recent report by M. Locke and P. Huie [*Science* **188**, 1219 (1975)] four words were left out in note 7, line 19. The sentence should read, "Staining on the section rather than in the tissue gave only a generally enhanced contrast without specificity."—Ed.

*Erratum:* In the article "Scientific Freedom and Responsibility" by J. T. Edsall [*Science* **188**, 687 (1975)], sentence 2, paragraph 4, column 1, page 689, should read: "Its use brought a dramatic halt to a typhus epidemic in Naples in World War II; its initial success in destroying agricultural pests was spectacular."

*Erratum:* On page 656 of the 22 August issue in a description of the Corning model 175 Blood Gas Analyzer, the fourth sentence from the end should have read, "It conducts a one-point calibration every 30 minutes. . . ."

†Other members of the Moudy group are former Congresswoman Edith Green, Elam K. Hertzler, Rocco A. Petrone, Gerard Piel, Clare W. Schweickart, and James H. Zumberge.