organization of vital interdisciplinary programs, how to evaluate the values of the past in relation to the future, and how to achieve a sense of community among students, faculty and citizenry (*7*).

References and Notes

1. The 1949 report of the Committee on Functions and Policies identified two types of education, professional (livelihood), and liberal (cultural and moral), and expressed confidence that the University was doing very well in meeting its obligations for professional education. The report was critical of the University's efforts in liberal education, however, and noted that "we must recognize a large measure of failure" in developing in students the "highest cultural and intellectual interests." But that report offered no clear definition of need nor provided the sense of urgency that might have produced significant efforts toward improvement. The report by the Interdisciplinary Committee in 1967, as drafted and revised by Professor Robert Siegfried of the Department of History of Science, commented that the University's position in providing adequate liberal education was even weaker than in 1949 when viewed against the terrifying greater need. The 1967 report is available upon request.
2. A statement on University purposes and principles was adopted by the University of Wisconsin Faculty Assembly, 26 February 1969. This statement included the following: "The purposes of a University are: (1) to provide students with optimum opportunity for learning from the heritage of the past, for gaining experience in use of their intellectual and creative capacities, and for developing themselves as concerned, responsible, humane citizens; (2) to extend the frontiers of knowledge through research; (3) to provide society with objective information and with imaginative approaches to the solutions of problems which can serve as a basis for sound decision-making in all areas."
3. J. Barzun, *The American University—How It Runs, Where It Is Going* (Harper & Row, New York, 1968).
4. Report to the Board of Regents by the University Faculty Council, Document No. 5, presented to the University Faculty Assembly, 3 February 1968.
5. *Crisis at Columbia*, Cox Commission Report (Random House, New York, 1968), pp. 19–24.
6. E. Gross, *Amer. Sociol. Rev.* **33**, 518 (1968).
7. On 1 December 1969 the faculty unanimously approved this document (Faculty Document No. 279) as "an appropriate and timely supplement to previous statements of University purpose and function" and specifically endorsed the statement of primary purpose.

NEWS AND COMMENT

Helium: Costs Jeopardize Future of Government Conservation Program

The fate of a government program to stockpile helium—a unique natural resource that is rapidly being wasted—is under review at high levels in the Nixon administration. The review was sparked largely by financial pressures. The government's helium conservation program, which provides for extracting helium from streams of natural gas and storing it underground for future use, has recently been running at a huge deficit. Everyone close to the situation agrees that something must be done to rectify the mess. But knowledgeable scientists are worried that the Nixon administration, in responding to short-range financial pressures, may allow the squandering of a priceless natural resource that may be desperately needed by future generations.

The outlines of the struggle are still somewhat indistinct, for much of the debate is going on behind closed doors. But, in general, the continuance of some kind of helium conservation effort seems to be favored by the scientific community and by the tiny helium industry, which profits from the existing program, while the need for further conservation has been questioned by economists and budget-oriented officials. One of the leading opponents of the conservation program is said to have been John F. O'Leary, who headed the Bureau of Mines until recently. (Helium activities accounted for almost half of the Bureau's entire 1969 budget of $117 million.) The leading scientific body that considered helium needs—a National Academy of Sciences committee—felt strongly that the conservation effort should be expanded, but its recommendations were toned down before publication because of protests by the Bureau of Mines.

The alarm over helium stems from the fact that it has unique properties for which there is often no real substitute in high-technology applications. Helium is the only gas which can be used to develop the low temperatures needed to attain superconductivity in metals, since it is the only known material that remains fluid at temperatures near absolute zero. It is also the lightest inert gas, is less soluble in fluids than any other gas, has the lowest liquefaction temperature of any gas, is the only known substance which will not freeze at atmospheric pressure, and has the lowest refractive index of any gas. Helium is nonflammable and nontoxic to man, has a small molecular cross section, and does not become radioactive.

These properties, singly and in combination, give helium many important uses, some of which are unique. The largest current use for helium is as a purging and pressurizing agent in liquid-fueled rockets. Expanding helium provides the pressure needed to push the rocket fuel to the engines, and helium keeps the propellant mixtures at the proper temperature.

Helium's lightness and nonflammability make it the safest lifting gas; its small molecular size and rarity in the atmosphere make it superb for leak detection; its nontoxicity and lightness make it valuable as a breathing mixture for underwater work; and its ability to reach low temperatures and gain superconductivity make it necessary for most kinds of super-cold applications. Helium is currently used extensively in shielded-arc welding and gas chromatography. It is also expected to play a key role in the development of nuclear reactors, lasers and masers, magnetohydrodynamics, and superconducting cables for transmitting electrical power.

The chief existing source of helium is certain natural gas reserves, of which the largest known happen to be located in the United States, primarily in Kansas, Oklahoma, and Texas. The helium in these reserves is generally thought to have been produced by long-term radioactive decay processes in which uranium and thorium emitted alpha particles (helium nuclei) which then captured electrons and became stable helium gas. The threat to this supply of helium lies in the fact that the natural gas supplies are used as a domestic household fuel. Unless the helium is extracted before the gas is delivered to the customer, it is passed into the atmosphere when the natural gas is burned.

In an effort to save this disappearing resource, the federal government launched a helium conservation program in 1960. The government has long been the leading user of helium, and the Bureau of Mines in the Depart-

ment of the Interior has operated its own helium extraction facilities for many years. Under legislation enacted in 1960, the Bureau also encouraged four private companies—Northern Helex, Cities Service Helex, National Helium, and Phillips Petroleum—to build additional extraction plants. The Bureau buys helium from the four companies under long-term (22-year) contracts and transports it through a Bureau-owned pipeline to an underground reservoir near Amarillo, Texas, where it is stored. Additional gas for storage is periodically produced by the Bureau's own plants. At the end of 1969, the reservoir contained about 24.2 billion cubic feet of helium—roughly a 30 years' supply at current rates of usage. But the program has recently cost more than expected and has accumulated gas more rapidly than anticipated. As a result, congressional committees have questioned the viability of the program and a review has been launched by the Nixon administration and its Interior Department.

It is hard to tell from the public record whether the conservation effort is apt to be abandoned, for no key official seems to have publicly recommended either droping or continuing the program. But a well-placed source in the Nixon administration told *Science*: "The conservationists are not crying wolf. At the highest levels of the administration, it is very seriously being considered to drop the program." The only public hint of the administration's intent comes in the proposed budget for fiscal 1971, which eliminated funds for further helium purchases pending the outcome of a survey of the conservation program. In a sentence which implies that the program is no longer needed, the budget document says: "A decrease in the projected demand for helium, together with technological developments that will augment the potential supply, has resulted in a decision to re-examine the need for the long-range helium program."

The conservation program, as eventually established, contemplated that the government would buy 62.5 billion cubic feet of helium from the four private contractors over the period 1961–83. The program in its early years was to be financed partly by loans from the Treasury, and partly by revenues from current helium sales, but it was ultimately supposed to pay for itself. The assumption was that the government would retain a monopoly or near monopoly of helium sales and thus could set its selling price at any level needed to make the program self-liquidating. Thus the government contracted to buy helium from the four companies at about $12 per 1000 cubic feet and it set an artificially high price of $35 per 1000 cubic feet for all sales to government agencies and other users. That price was designed to liquidate the program within 35 years.

Unfortunately, things didn't work out as planned. The total demand for helium has recently been running be-

Environmental Teach-In: University of Michigan Meeting

Ann Arbor, Michigan. In the 4-day Environmental Teach-In held here at the University of Michigan last week even the "moderates" were talking like radicals and attacking not merely pollution but the system that produces it. The Teach-In, which at times generated a revival atmosphere, was a precursor of the National Environmental Teach-In, to be held on 22 April ("Earth Day") at hundreds of colleges and universities. As such, it is worth examining for prophetic signs. This huge institution, with its enrollment of 32,000 and its remarkable diversity of students and faculty, has proven to be an unusually fertile nursery for activist causes that eventually sweep the nation. It was here that the first Vietnam Teach-In was held, an event that set the stage for massive national protests against the war.

Whatever the potential of this newest cause for shaking up the status quo, the Teach-In was boycotted by the university's Black Action Movement, which viewed it as another fatuous delusion of the white middle class.

As matters developed, however, the Teach-In pointed up a tendency of students to view the environmental issue as inseparable from the racial crisis and the war issue. Moreover, many students clearly believe that no solution to problems of the environment will be found without profound changes in the economic system and in the individual "life styles."

Denis Hayes, coordinator of the National Teach-In and one of the numerous visitors here (more than 50 teach-in organizers came from other campuses), expressed a point of view widely shared by Michigan students when he appeared before U.S. Representative E. Henry Reuss' Subcommittee on Conservation and Natural Resources, which conducted a special hearing here during the Teach-In. "Most of the politicians and businessmen who are jumping on the environmental bandwagon haven't the slightest idea what they're getting into," said Hayes, who was president of the student body at Stanford last year. "They don't realize that we are going to need values. . . . This country consumes resources at an extravagant rate and gags on its own garbage. Something is drastically wrong. Pollution is only one symptom of the environmental crisis in this nation. We are spending insanely large sums on military hardware instead of eliminating hunger and poverty. We squander resources on moon dust while people live in wretched housing, and we still waste money and lives in a war we should never have entered."

Dozens of seminars, workshops, rallies, and other events (such as the "trial" of an automobile accused of pollution and its subsequent "execution" by students wielding sledgehammers) were held during the 4 days of the teach-in. Among the participants were Senator Edmund Muskie of Maine, Senator Gaylord Nelson of Wisconsin, Senator Philip A. Hart of Michigan, Ralph Nader, a half dozen Congressmen, Michigan's Governor William Milliken, Walter Reuther of the United Automobile Workers, the president of Dow Chemical, Mayor Richard Hatcher of Gary, Indiana, Arthur Godfrey, folk singer Gordon Lightfoot, the cast of "Hair," and such eco-celebrities from academe as Barry Commoner of Washington University, Lamont Cole of Cornell, and Lawrence B. Slobodkin of Stony Brook.

Commoner, who has been called ecology's Paul Revere, was the principal speaker at a kickoff rally attended by more

hind projections, largely because of a slackening of activity in the space program. And to make matters worse for the government, a small private helium industry has sprung up that operates independently of the conservation program. A handful of private companies, including two companies related to those that supply helium to the government under contract, have built their own extraction facilities and are competing with the government program. The private plants undersell the government by $10 to $15 per 1000 cubic feet. They are not able to sell directly to government agencies, but they have captured about 45 percent of the total helium market by selling to private industry and to contractors that work for the government. This competition has reduced the revenues of the conservation program and has forced it to borrow additional money from the treasury. Meanwhile interest rates have soared far beyond expectations, thus increasing the costs of the program. The program entered fiscal year 1970 with about $18 million in unpaid bills. Under existing conditions, Interior Department officials say the program is "financially untenable" and will not be self-liquidating in 35 years as required.

In an effort to cut costs, the Bureau of Mines has closed down two of its older helium plants and is phasing out a third. It is also shutting its Helium Research Center near Amarillo, which has some 69 employees and an annual budget of some $1.2 million. "We feel it is pure folly to shut us down," says L. W. Brandt, the center's director. "Continuing research is needed." Laboratory personnel are particularly upset that the closing notice came without warning and without prior consultation with them. "It's a hell of way to phase out a facility," says Robert Barieau, the center's project leader in thermodynamics.

The problems confronting the conservation program have led some authorities to suggest that it be abandoned or reevaluated. Lee E. Preston, an economist at the State University of New York at Buffalo, has conducted a cost-benefit analysis of the program and concluded that "additional purchases for storage should cease as soon as possible." The General Accounting Office (GAO), the House Appropriations Committee, and the Budget Bureau have also raised questions. A recent GAO report was so negative in tone that the helium industry charged it was "apparently designed to justify cancellation of the entire program." The picture is complicated by the fact that the program has long had the aura of a "give-away" to the helium companies. At least one House member has scornfully called it "the Helium Poverty Program," and a 1963 GAO report charged that the government would incur "unjustified costs" of at least $155 million over the life of the helium contracts.

Those who argue for curtailing or canceling the conservation program generally contend that there is already

Links Concerns about Pollution and "Upside-Down Society"

than 13,000 persons. He said that the teach-in "epitomizes the remarkable convergence around the environmental issue of a number of earlier, separate concerns: conservation, the scientists' responsibility for the social consequence of science and technology, the consumer movement, the new generation's feeling for a more humane life style, the businessman's worries over the impact of all of these on industrial profits, the problem of the ghetto and urban decay, the antiwar movement, student activism against the nation's social and economic system."

Commoner said that for blacks to shun the environmental movement would be unfortunate, because they are the special victims of pollution. "A white suburbanite," he noted, "can escape from the city's dirt, smog, carbon monoxide, lead, and noise when he goes home. The ghetto dweller not only works in a polluted environment, he lives in it."

Commoner said that pollution has been an intrinsic feature, not a by-product, of increased production and technological progress. Accordingly, efforts to cope, he added, will produce serious economic dislocations, which nevertheless must be endured since human survival is at stake. Commoner was warmly applauded, although neither he nor other speakers escaped a bit of heckling from the SDS revolutionaries.

Later in the week, Ralph Nader received a standing ovation for his attacks on General Motors and other major companies as "corporate criminals." Leaders of the teach-in sent a letter to Robben W. Fleming, president of the University of Michigan, urging that the university use its $2.5-million holdings of General Motors stock in support of the Nader-inspired Project on Corporate Responsibility. One goal of this project is to have GM stop releasing through its plant operations and the vehicles it produces 45 million tons (Nader's figures) of pollutants into the air each year.

From what could be observed during the teach-in, there was substantial student support for proposals calculated to help turn the "upside-down society" (a phrase Nader uses) right side up. These included proposals for substituting mass transit systems for the automobile in cities, for less personal consumption generally, and a return to a simpler life; for the legalization of abortions and the adoption of other measures (such as tax disincentives) to encourage attainment of the two-child family as the national norm; for class actions in the courts against polluters; for campaign support of politicians who show ecological awareness; and for other measures, such as those to require the reuse or recycling of bottles, cans, paper, and other materials. An *Environmental Handbook,* rich in such proposals, has been published by Friends of the Earth and Ballantine Books, Inc., for the teach-in movement, and 600,000 copies are in print.

Are the teach-ins, in fact, leading somewhere? Plans for a follow-through effort here are still vague, although an Environmental Law Society has been formed and it may soon bring its first suit. Yet, the teach-in movement may well be the start of something big. The environmental crisis is real enough even if the doomsday prophecies that one hears are highly conjectural. Moreover, enormous student energies are in need of an outlet now that militant black students want no part of white collaborators and now that President Nixon has (for the moment at least) deescalated the war issue by keeping draft calls low.—LUTHER J. CARTER

plenty of helium in storage or in newly found gas reserves to meet foreseeable demand for many, many years; that there is a potential for discovering new helium reserves, especially since no systematic exploration for helium has ever been undertaken; and that improvements in technology will undoubtedly permit extraction of helium from gas sources previously considered too lean for economical use. Since these analysts foresee no shortage of helium, they consider costs the crucial question, and they conclude that the present conservation program is too costly a way to meet future needs.

Informed elements of the scientific community, on the other hand, argue that a vital element should be conserved even if the program can't pay for itself as originally planned. "It should be run like a conservation program, not like a business," says Preston E. Cloud, Jr., chairman of the National Academy of Sciences committee that produced a recent report on "Resources and Man." The members of Cloud's committee unanimously agreed that helium is an irreplaceable commodity that is being wasted in great quantities. They originally wrote a recommendation urging that the conservation program be expanded to extract helium from leaner sources. But before the committee's report was published, it was circulated, as a matter of courtesy, to the sponsors who provided financial support. One of these sponsors—the Bureau of Mines—objected. The Bureau had no veto power over the committee's recommendations, but Cloud says the Bureau claimed that more recent data than that relied upon by the committee "raised questions about our helium recommendation as originally written." Cloud said that because of the Bureau's objections, and because it is always possible that helium will eventually be produced by nuclear fusion or perhaps even by extraction from the atmosphere, he reworded his committee's report so that it simply calls for reevaluation of the conservation program and subsequent expansion if deemed necessary. However, Cloud said he strongly believes, as an individual, that conservation should be continued and expanded. "To say that something will come along [to ensure an adequate helium supply] is an act of faith that shouldn't be used as a basis for public policy," he added.

The Office of Science and Technology, headed by Lee A. DuBridge, President Nixon's science adviser, is also said to favor continued conservation, though it won't comment on the issue on the grounds that its advice is intended solely for the White House. OST is said to believe that while the conservation program may need reform, it would be a "bad mistake" to allow rich supplies of helium to escape into the atmosphere.

The cause of conservation is also being promoted by a small-scale industrial-academic complex. The companies that hold helium extraction contracts with the government have organized a Helium Society and have enlisted more than 1100 members, mostly from the academic world. The Society has hired M. Scott Carpenter, the former astronaut, to act as its president. It will hold a symposium in Washington, D.C., on 23 and 24 March. James R. Killian, Jr., former science adviser to President Eisenhower, will act as honorary chairman, and a slew of helium experts will give papers.

The debate over helium conservation stems largely from a difference in gut feelings about the future. Conservationists view helium as an irreplaceable resource. They believe it is in danger of being wasted with no real assurance that an alternate supply will be found or a substitute material developed to meet potentially sizable future needs. Critics of the program, on the other hand, suspect that large quantities of gas are being stored at unreasonable cost to meet futuristic demands that can barely be foreseen. They believe there are cheaper ways than long-term storage to meet whatever needs may develop. Each side comes up with differing estimates of future supply and demand and differing conclusions as to whether helium conservation is necessary and desirable. Hopefully the Nixon administration and the appropriate congressional committees will sift through the conflicting claims and make certain that a precious natural resource is not squandered simply because the existing conservation program has run into severe problems.—PHILIP M. BOFFEY

Research in Britain: A Non-Weeping Formula for Living on Tight Funds

London. American research leaders might profitably interrupt their marathon last rites for science in the U.S. and examine a policy statement that outlines how their British counterparts plan to live with the common problem of a shortfall between money and scientific ambitions.

In large part, the British are pointed toward an elitist solution: support the best, concentrate expensive facilities, and let the others get along as well as they can. This, of course, is a prescription that is easy to apply in Britain, where Parliament is passive, and difficult to apply in the U.S., where Congress rages for equal shares. Furthermore, British scientists remain relatively well supported and are virtually free of the violent financial fluctuations that are currently disturbing academic research in the U.S. Their support is on a long-term basis, and an appreciable annual growth rate, now 6 percent in real purchasing power, is built into the overall system. Nevertheless, they are up against the problem of making do with less than they deem desirable, and, since Britain is an old hand at funding academic science from the public purse, it is illuminating to look at the thinking behind the policies that are supposed to govern the administration of research in the coming years. This thinking was set forth in a 12,000-word policy statement by Sir Brian H. Flowers, a physicist and Fellow of the Royal Society, who chairs the Science Research Council (SRC), a $100-million-a-year organization similar in function to the U.S. National Science Foundation.

Speaking on 6 March, at Nottingham University, on "Science in the Universities," * Flowers committed what

* Copies may be obtained, without charge, from the Public Relations Unit, Science Research Council, State House, High Holborn, London W.C.1, England.