Harvard, Science, and the Company of Educated Men and Women

Reform of the undergraduate curriculum is back in fashion as American colleges and universities committed to the idea of liberal education seek a pathway from the experimentalism of the 1960's past the vocationalism of the present. Recent moves at Harvard to institute a "core curriculum" have drawn wide attention, not because Harvard was first or has gone farthest with reform but because it is Harvard and, perhaps, because the debate there has been sharply drawn.

Opinion has divided along disciplinary lines, with faculty in the natural sciences in general least supportive of the proposed changes on the grounds that they do not go far enough in educating the majority of undergraduates for modern technological society. The discussion has provided interesting testimony on where science stands in the research university, a reminder that the two cultures of C. P. Snow's hackneyed but hardy metaphor still live.

The driving force behind the core curriculum has been Henry Rosovsky, dean of the faculty of arts and sciences, who has had the solid backing of Harvard president Derek Bok. Last year, in reporting that Rosovsky had turned down the proferred presidency of Yale, the press attributed the turndown to his commitment to carrying through on the core curriculum. Some Harvard faculty saw Rosovsky's renunciation as an astute gamesman's ploy—faculty members could hardly oppose the curriculum changes too strenuously without feeling churlish. Looked at another way, however, Rosovsky, in staying at Harvard, was recognizing that the success of the core curriculum depends heavily on follow-through by the faculty encouraged by continued interest by the administration.

By all accounts, scientists, as a disciplinary group, are the most skeptical about the core curriculum. Their attitude appears to be very much the same one they hold toward Harvard's present "general education" program. In bald terms their view is that not enough science is required in the curriculum for students outside the sciences to understand the substance or methods of science. Furthermore, there is a feeling that standards have been made so flexible that it is easy to evade even the year of science courses which has been required. In other words, they question that the university is achieving its avowed purpose of preparing students to join "the company of educated men and women."

A significant segment of scientists at Harvard feel that the core curriculum requirements do a disservice by implying that the minimal science and mathematics standards set are adequate in a technological age. The expression of this view most often referred to was in remarks by chemistry professor Frank H. Westheimer at a 14 March faculty meeting.

Westheimer urged the faculty to reject the core curriculum despite his view that the curriculum provided "a reasonable if minimal general education for students of science." The problem, said Westheimer, is with students in the social and behavioral sciences and, particularly, in the humanities. He made his main point in his written remarks prepared for the meeting:

> Some of my colleagues in the sciences suggest that we recognize the dichotomy between the two cultures; since students in science will get a decent basic education under the new system, we can, perhaps, afford to shrug our shoulders. If the humanists decide that one half-course in physical science and/or mathematics, plus one half-course in either biological or behavioral science is enough to provide a minimum background for the appreciation of our technological world, well, what concern is that of ours? But even if I felt no responsibility to tell my colleagues that I do not agree. I would still worry about the signal that this Core Curriculum will give to the world. Harvard, for better or worse, is highly regarded and widely imitated. This curriculum is a public statement of what our faculty regards as important. I question whether this institution should now announce that, in our judgment, science occupies a minor, perhaps only a trivial, place in the intellectual heritage of mankind.

For some scientists, the feeling of estrangement is fueled by a sense that Harvard has been systematically "anti-science." As evidence, it is asserted that, to win admission to Harvard College, it is essential that an applicant have very high verbal test scores, but not as essential to have equally high math scores. Ergo, verbal ability is prized more highly than quantitative ability. Further proof of bias is seen in the substantially greater percentage increases in humanities and social and behavioral sciences faculty than in natural sciences faculty at Harvard since World War II. And the flow of university resources into facilities for other disciplines is also noted.

The idea that there is an antiscience bias was disputed by other scientists who, in refutation, cite light teaching loads in science departments, and provision of more than satisfactory lab, office, and library facilities for science. The contrast is also made between recent sharp cutbacks in graduate programs in nonscience areas, especially the humanities, and the relatively moderate reduc-

Core Curriculum

Harvard's 4-year undergraduate curriculum gives 2 years to subjects in a student's "concentration" (major), a year to electives, and a year to what until now has been called general education. It is this year of general education subjects which the core curriculum would supplant.

Core requirements will involve five "areas": (i) arts and letters, (ii) history, (iii) social and philosophical analysis, (iv) science and mathematics, and (v) foreign languages and cultures. The student will be required to take two courses in each of four areas outside his field of concentration; that is, eight half-year courses. In addition, he or she will have to fulfill proficiency requirements in foreign language, writing, and mathematics to graduate.

At this point, the Harvard faculty has approved the administration's proposal in principle, and has begun the process of change. Working groups in each of the subject areas have been formed and details of the math, language, and writing requirements are being thrashed out. The core curriculum is to be built up to perhaps 100 courses over 4 years. Then progress will be reviewed and the faculty asked to vote on whether the experiment is working.

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Follow-up on the Budget

The President's budget, which is essentially a compendium of requests for funds by the Executive Branch, gets a lot of attention when it appears each January, but the question of how Congress actually deals with those requests tends to be lost in the piecemeal appropriations process. The lag in accounting the fate of particular elements, such as the federal science budget, is usually considerable. In an effort to sort out and sum up budget activity in the R & D sector, Willis Shapley and Don I. Phillips of the AAAS have prepared an analysis—*Congressional Action Research and Development in the FY 1979 Budget**—that shows some science agencies did better in the end than others.

Agencies to which the Congress most notably gave funding boosts beyond the Carter requests were the National Institutes of Health, Department of Energy, and Department of Agriculture. Major losers were the National Science Foundation, Department of Defense, and National Aeronautics and Space Administration. With the annual rate of inflation estimated at 7 percent, the report surmises that the latter three agencies will barely hold their own in terms of constant dollars. The table below, taken from the report, provides the comparative figures.

Shapley and Phillips find that, by and large, Administration R & D initiatives met "something of a mixed fate in Congress." And they observe that "There was no general congressional policy framework for R & D." So if Congress is arbitrary with Administration science policy, it is not because it has one of its own.—J.W.

Congressional action on R & D in the FY 1979 budget (budget authority in millions of dollars). The figures include funds for the conduct of R & D and for R & D facilities.

Agency	FY 1979 budget	Action by Congress		Percent change	
		Approved	Change	From budget	From 1978
Defense (military functions)	13,014.2	12,685.4	−328,8	− 2.5	+ 6.3
Energy	5,048.5	5,316.7	+268.2	+ 5.3	+ 9.0
Budget amendments (net)	+50.5	+53.5	+ 3.0	+ 5.9	
Total, energy	5,099.0	5,370.2	+271.2	+ 5.3	+10.1
National Aeronautics and Space Administration	4,345.0	4,323.6	− 21.4	− 0.5	+ 7.1
Health, Education, and Welfare					
National Institutes of Health	2,646.5	2,998.2	+351.7	+13.3	+13.9
All other	652.6	639.5	− 13.1	− 2.0	+ 5.7
Total HEW	3,299.1	3,637.7	+338.6	+10.3	+12.4
National Science Foundation	867.6	842.2	− 25.4	− 2.9	+ 6.5
Agriculture	624.6	695.6	+ 71.0	+11.4	+10.4
Environmental Protection Agency	352.7	355.6	+ 2.9	+ 0.8	+ 2.5
Interior	344.4	372.1	+ 27.7	+ 8.0	+ 3.4
Transportation	363.0	355.6	− 7.4	− 2.0	− 1.5
Commerce	326.4	315.7	− 10.7	− 3.3	+ 7.0
Nuclear Regulatory Commission	155.5	151.0	− 4.5	− 2.9	+14.4
Agency for International Development	75.7	67.9	− 7.8	−10.3	+38.5
Veterans Administration	112.7	122.8	+ 10.1	+ 8.9	+ 5.8
Housing and Urban Development	57.0	52.5	− 4.5	− 7.9	+ 2.9
Justice	42.8	42.8			+ 7.0
Labor	40.4	38.9	− 1.5	− 3.7	+17.9
Smithsonian	33.6	33.6			+ 5.0
Corps of Engineers (civil)	27.6	27.6			− 1.4
Tennessee Valley Authority	32.1	38.1	+ 6.0	+18.7	+19.1
All other agencies	34.1	34.1			+10.0
Total, January budget	29,197.0	29,509.5	+312.5	+ 1.1	+ 7.7
Budget amendments (net)	+50.5	+53.5	+ 3.0	+ 5.9	
Total	29,247.5	29,563.0	+315.5	+ 1.1	+ 7.9

* Available from the AAAS Office of Public Sector Programs, 1776 Massachusetts Avenue, NW, Washington, D.C. 20036, or from the following cooperating societies: Association of American Universities, American Institute of Aeronautics and Astronautics, American Institute of Biological Sciences, American Psychological Association, American Society of Mechanical Engineers, National Association of State Universities and Land Grant Colleges.

tions in science graduate programs. As for undergraduate test scores, no definitive data comparing scientific and nonscientific types seems to be available. University administration officials do suggest, however, that Harvard students generally score so high that differences would not be very significant.

The view that Harvard harbors an antiscience bias appears to be a minority opinion among scientists. On the other hand, it is generally agreed that natural sciences faculty as a group are coolest to the core curriculum and that within this group there is a definite spectrum of opinion with physical scientists most critical of the new curriculum and applied scientists and biological scientists, in that order, less resistant. Social and behavioral scientists are regarded as more friendly and the humanities faculty as most receptive.

By no means all "hard" scientists oppose the core curriculum. A number of scientists prominent on the faculty, including some in the physical sciences, have indicated support either by their remarks in faculty meetings or by agreeing to consider teaching core courses. Examples are professors Henry Ehrenreich (applied physics) and Sheldon Glashow and Steven Weinberg (physics).

These scientists, however, tend to qualify their support in a particular way. They concur with Westheimer's view that it is deplorable that so few people reach a level of understanding of science which allows them to appreciate what is going on in the world of research. However, they agree that is is desirable to give undergraduates an intellectual "common ground," if that is possible, and accept that a compromise among disciplines was necessary for the core curriculum to be accepted. They are willing to reserve judgment on whether the effort will work, and, in varying degrees, are ready to pitch in themselves.

In objecting to the core curriculum, a number of scientists say they fear that the new requirements will deter very bright, highly motivated science students from coming to Harvard. There is a type of student who is completely science oriented and totally committed to a particular kind of specialization, and who wants to pursue that exclusively. To require such students to spend three quarters of their time rather than all of it on science might dissuade them from choosing Harvard.

At this stage, there seems no way to prove or disprove this argument. But proponents of the core curriculum say that many science students at Harvard eventually express regrets that they ig-

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nored opportunities in other disciplines when they were freshmen and sophomores. Rosovsky suggests that the core curriculum may be a good form of advising, since it is difficult to get faculty members to advise students effectively.

The use of the word "remedial," often used by opponents of the core curriculum in referring to science and math courses for the program, in relation to the core curriculum has become a kind of code word for some faculty members concerned that it will be necessary to hire special faculty to teach it. They see such a need for teaching at remedial level arising if core curriculum courses are made challenging, because, as one scientist put it, "humanists can't hack the science." He went on to observe that "Harvard faculty are not selected on the basis of remedial teaching, they have no ability and no stomach for it."

Others invoke the experience of the Universty of Chicago under president Robert Hutchins when special faculty were hired to teach in the general education program.

Rosovsky is emphatic in saying that the university "does not intend to recreate a Chicago situation of core faculty and regular faculty." Course sections will be taught by teaching fellows as they are now. Something of a shortage of this sort of manpower exists at Harvard because of the decline in graduate programs and Rosovsky says the university may reinstitute the use of instructors. These, however, would be Ph.D.'s with a "reasonable opportunity" for academic advancement. There will be no "underclass" of faculty, says Rosovsky.

There is agreement on all hands that the success of the core curriculum will depend on the willingness of senior faculty to develop new courses for the program. General education in its heyday flourished because of the tone set by faculty luminaries who combined command of their subject with the ability to deliver bravura lecture performances. Political scientist Samuel Beer and Nobelist biochemist George Wald were among those notables who maintained the tradition through the 1960's, and physicist and Nobel prize winner Edward Purcell is widely recognized at Harvard for his commitment to undergraduate teaching.

Both advocates and opponents tend to agree that the core curriculum does not differ basically from the general education requirements which held sway at Harvard and elsewhere in the 1950's and 1960's. Rosovsky himself says that the core curriculum "updates" general education. The need for change arises because general education lost its original impetus. As course offerings became more specialized and idiosyncratic and the number of undemanding courses increased, the coherence and quality of general education declined and the attitudes of students and faculty soured.

Harvard Yard

General education was the product of a particular time, the period immediately after World War II, when James B. Conant was Harvard's president. General education was in part a reaction to the indifferent state of education in American high schools at the time. But general education was in a broader sense a response to the recent war and the emerging Cold War. As one faculty member puts it, confrontation with another wave of barbarians was foreseen and the universities embraced the responsibility of training "magistrates" for the struggle. *General Education in a Free Society*, the so-called "redbook," expressed the rationale for the program. The rhetoric of the redbook was never fully accepted at Harvard, but it contributed to a sense of national mission which was part of the atmosphere of the times, and not only at Harvard.

The core curriculum has a quite different historical setting. American secondary schools, at least the private schools and high schools in affluent suburbs from which the majority of Harvard students come, provide better preparation than the schools of the 1940's. And the wrenching social and political experience of the civil rights movement, Vietnam war, and Watergate have drastically modified the country's sense of mission. The core curriculum's sponsors have sought to construct the core curriculum so that it better comprehends non-Western history and cultures as the redbook did not and deals better with the "fragmentation" of knowledge, but what one faculty member called the "quasi-political oomph" of the earlier period is missing.

Of course the university itself has changed decidedly in the past generation. Specialization—what one faculty member called specialism—has altered the academic value system. The most widely noted change has been the shift in faculty loyalties with the faculty members allegiance going mainly to his discipline, not to the university and certainly not to undergraduate teaching.

The centripetal forces are strongest in the research universities. It is not surprising that the question of undergraduate teaching focused tensions at Harvard, but the research-versus-teaching issue is by no means the only one operating. Another is what might be called the issue of "free choice" by students. In the 1960's a variety of forces, ranging from protests against intellectual elitism to draft deferments for those who maintained passing marks, brought a relaxation both of grading standards and formal course requirements on most American campuses. Harvard stands somewhere in the middle in respect to its policy on requirements, and the core curriculum will probably be perceived as moving it further in the direction of the restoration of "rigor."

In the Ivy League, Columbia is regarded as having held on hardest to distribution requirements, while Brown is seen as having gone farthest in offering

flexibility. Among selective liberal arts colleges a varied pattern prevails. Tufts, for example, seems to have made relatively minor changes in formal curriculum requirements over the years. Middlebury College, which followed a fairly general trend toward free choice in the late 1960's, attracted attention 2 years ago as marking a countertrend when it added a spread of "foundation courses" to its requirements for graduation. It is

Henry Rosovsky

worth noting that attitudes of liberal arts college science faculty toward science courses of the core-curriculum sort seem to differ significantly from those of their counterparts in research universities. At Middlebury, for example, the original initiative for curriculum change came from the faculty rather than the administration and science faculty appear to concur on the worth of foundation courses in science, some regarding them as providing an opportunity to make converts. A "teaching tradition" persists at liberal arts colleges, but some observers speculate that constriction of the academic job market may result in able but research-oriented young faculty taking jobs in liberal arts colleges and a consequent infusion of the research-university spirit there.

Among some private and public colleges and universities, there is caution about "tightening up" because of its possible discouraging effect on applicants at a time of adverse demographics. At Harvard, market considerations are not primary, so that the core curriculum has been discussed, so to speak, on its merits.

A scientist who has been pro-core curriculum from the outset is E. O. Wilson, professor of zoology, author of *Sociobiology* and best known exponent of the subject. Wilson thinks that "Bok and Rosovsky saw higher education in disarray. They saw that the logical thing for the administration to do was to pull the faculty together, challenge them with the proposition that a core curriculum is possible, that Western civilization has not just exploded into pieces and will never come together again." Wilson says he feels that the Harvard faculty should exercise some responsibility in trying to achieve their aim.

The task is difficult, he says, because of the information explosion. In the natural sciences and social sciences, for example, the number of journals doubles every 10 years. "In 1945, it was possible for scholars to sit around and suppose that certain bodies of knowledge could be summarized in survey courses. No one makes that presumption now."

The challenge is not to identify all important parts of knowledge, says Wilson, but rather to convey what are the essential ideas, the most interesting and challenging information. Why this is so hard for scientists now is because they are not able to cope with broad sectors of knowledge. "The image of the scientist has changed. Scientists are no longer thought of as savants in charge of a large part of knowledge. Increasingly, they are regarded as test-tube jockeys, specialists on a narrow front." It is expecting a lot to ask a scientist to be in the forefront and also a generalist. But admitting that its difficult to develop a core curriculum, says Wilson, is no reason to give up the effort to develop one.

The discussion of the core curriculum during three faculty meetings last spring included some wide ranging reflections on the purposes of the university, but Rosovsky himself sees the case for the core curriculum resting at least in part on a clear obligation to Harvard's undergraduates. In an interview, he observed that Harvard is a "great university which contains an undergraduate college. In a research university the faculty has to meet responsibilities for undergraduate as well as graduate education." That is a hallmark of the American university. Those responsibilities can be met, said Rosovsky, only if research faculty deals with all types of students.

When Rosovsky began to look at the situation 5 years ago he says he found himself compelled to ask "Have undergraduates been getting a fair share of the resources of the university. I concluded that in the 1960's, in general they did not, except perhaps for the top 5 percent of students."

The core curriculum then is in part an attempt to give undergraduates a fairer share. In asking faculty members to participate in redesigning liberal education and implementing the revised version the administration was also asking them to reconsider what their job is. And that could be as important as whether the Harvard graduate of the future can discuss the Second Law of Thermodynamics.—JOHN WALSH

Briefing

One U.S. Group Cancels a Soviet Exchange . . .

The Information Theory (IT) group of the Institute of Electrical and Electronics Engineers has effectively canceled a U.S.-Soviet exchange program because of the Soviets' eleventh-hour refusal to allow some of their most distinguished scientists to visit the United States.

In late October, 4 days before the beginning of a planned week-long U.S.-Soviet symposium on information theory in Mount Kisco, New York, Aaron Wyner of Bell Laboratories, the U.S. organizer, learned that the two leading members of the planned Soviet delegation would not be coming.

Yet for nearly a year, the Soviets had been assuring the Americans that a "very strong" delegation consisting of 14 people the Americans wanted to come would be able to attend. Included in this list were the two leading Soviet contributors to information theory, Mark Pinsker and Roland Dobrushin. Dobrushin is also highly regarded as a mathematician. Although both are Jews, they are part of the establishment. Neither has applied to emigrate to Israel or done anything controversial. The episode is typical of the frustrations that many American scientists have encountered in trying to have meaningful scientific exchanges with their Soviet counterparts.

The IT group signed an exchange agreement with the Working Group on Information Theory of the Soviet Academy of Sciences in 1974. The first joint workshop was held in Moscow in December 1975. In return for the Moscow meeting, the Americans planned to have a 1-week-long symposium prior to a major international meeting of the IT group in Ithaca, New York in October 1977. But when the Soviets proposed a delegation for this workshop that the Americans found "weak," they postponed it for a year.

Wyner says that from 1977 on, the IT group members made clear, both officially and in private talks with their Soviet colleagues, that they would like a strong delegation to come to the October 1978 workshop. "We never delivered an ultimatum, but they knew who we wanted," he says. Their firmness seemed to be rewarded when the Soviets agreed to a 14-member delegation that unexpectedly

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