The MIT Faculty Newsletter

Vol. III No. 6 April 1991

Biology Requirement Vote Expected At May Meeting

Jonathan King

The integration of modern biological science into the core science requirement for MIT undergraduates took a major step forward at the April faculty meeting. The motion from the Committee on the Undergraduate Program was favorably discussed. Biology Chair Richard Hynes reported the Department's willingness to take on the task of providing superior general instruction in modern biology and presented the Department's proposals for implementing the Biology Requirement.

Professor Hynes emphasized the Department's decision to focus on the molecular and genetic basis of the development, function, and reproduction of organisms, providing the foundation for an understanding of the impacts of modern biology on technology and society, and for further work in biology.

Biology faculty will teach a one semester course covering the core of modern biology (Table 1). Given the diversity within the biological sciences among the undergraduates this will be offered in a number of "flavors" (Table 2). [Tables, Page 12.] Each version will cover a common core, taking up about 2/3 of the course,

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The Complexion of Scientific Communities

Kenneth R. Manning

[*The following is Part One of a two-part excerpt from the Sarton Memorial Lecture, February 1991.*]

History is full of indications that the neat, tidy, uniform perspective held by many scientists does not take into account the complex social factors that have influenced the scientific enterprise. If we examine just one aspect of this - the degree to which science has assumed the characteristics of a multi-complexioned enterprise, by that I mean an inclusionary outlook and a diversity of participation - we can get a sense of how closely the scientific community reflects trends in the larger society. The reflection appears almost as a mirror image. The attitude of the scientific community with respect to broadening, diversifying, and integrating its ranks has basically followed the pattern of other social institutions. The notion of science as a color-free endeavor is not borne out by the historical evidence.

Perhaps, we can take a metaphor from Newtonian optics and apply it to social experience. Like a ray of light, the scientific community is one thing on the surface, a uniform streak or

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Editorial

Ethics and Ethos

Scandals involving spurious reports of research results and the falsification of laboratory data are a spreading stain on the scientific community. Beyond the troubling feelings engendered in us by the painful personal and professional predicaments of the principals in the case, the recent allegations of fraud and scientific misconduct in an MIT laboratory raise many disturbing questions about prevailing standards of academic responsibility and integrity; questions that all of us who live and work and study at this institution must seriously address.

In his initial public response (reported in *Tech Talk* on April 3, 1991) MIT President Charles M. Vest took note of the adverse impact of such allegations of academic impropriety on ourselves, our colleagues and students, our institution, the public perception, and our relations with the federal government.

After looking into existing procedures for dealing with allegations of academic misconduct, and after taking due note of some "efforts ongoing at the departmental level to design specific procedures to foster

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academic integrity and to deal with concerns regarding appropriate academic behavior," President Vest concluded that additional actions were in order.

Accordingly, he and Provost Mark S. Wrighton subsequently announced the creation of a special faculty Committee on Academic Responsibilities, and charged the committee with:

1) reviewing and articulating the values MIT holds in the conduct of academic research;

2) looking at MIT's own policies and procedures in view of those values;

3) comparing MIT's policies and procedures with federal and private guidelines governing research grants and contracts and suggesting constructive changes in MIT's current practices; and

4) suggesting creative ways of introducing mentoring and educational programs regarding the conduct of research and broad career guidance throughout the entire research community at MIT.

The initial selection of Professor Sheila E. Widnall of the Department of Aeronautics and Astronautics as committee chair has since been followed by the appointment of four additional faculty members to serve with her. (As reported in *Tech Talk* on April 24, 1991, they are Institute Professor Morris Halle of the Department of Linguistics and Philosophy; Professor of Physics Jerome I. Friedman; Associate Professor of Molecular Biology Richard C. Mulligan, and Professor Gerald N. Wogan, director of the Division of Toxicology.)

In announcing its establishment, the provost made a point of emphasizing that the Committee was expected to consider "the whole issue of academic integrity." In our view, nothing is more important to the future well-being of this extraordinary Institute than for the Committee - and the MIT community at large - to define and to deal with this issue **in the broadest and most searching of terms.** Systematic and highly influential connections always and everywhere exist between the way a problem is initially defined and what is ultimately done - and **not** done - to solve it.

A further reason for insisting on the importance of definitional breadth is that the set of values held at MIT concerning "the conduct of academic research" is but a subset of the values associated with the bigger and broader issues of academic responsibility and integrity. Existing MIT policies and procedures regarding academic integrity and responsibility must be identified and reviewed before they can be meaningfully evaluated as to their appropriateness and adequacy. The four point charge to the Committee is essentially a means (points 2-4) to an end (point 1).

As the charge to the Committee makes plain, all of this needs to be done in the context of a clearly articulated and consensually-shared sense of the values that we at MIT share regarding academic responsibility and integrity. And here we come to the heart of the matter.

Lofty sentiments aside, there simply does not exist at this time within the MIT community, any consensually-agreed-upon, clearly articulated substantive sense of the values that this community "stands for" insofar as the subjects of research conduct, academic responsibility, and academic integrity are concerned. Accordingly, we urge the Committee to try to determine, **first of all**, the precise nature and scope of the relevant values that presently **do** prevail at MIT. An attempt should be made to identify some set of core values that all members of the MIT community can and **should** be expected to hold, to adhere to, and to respect, regarding "the whole issue of scientific integrity."

These suggestions to the Committee arise from our own present vantage point as interested and concerned members of the academic community. In our view, cases like the one in question are best understood as being but the latest and most notorious manifestations of a much broader and deeper crisis of values.

There could be no greater misconception of its meaning than to believe this crisis to be concerned merely or even mainly with lapses of academic integrity on the part of a few misguided individuals. Such lapses are, to be sure, both noteworthy and deplorable. But the crisis of which these are but the symptoms is, in essence, more broadly and more systemically concerned with the failure of communities like ours to clearly, consistently, and unequivocally practice what we preach.

There are, of course, many reasons why it is not easy for institutions like MIT to unfailingly exhibit in their overall day-to-day organizational behavior, the values of individual and collective trustworthiness, honesty, and truth-telling upon which the integrity of academic scholarship ultimately depends. One reason is the changing nature of scholarship. Science, as we all know, has become a big business as well as a highly specialized, extremely competitive, high-stakes, hierarchically-organized power-oriented academic and professional enterprise. In the process of its development in this direction, there

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has been a marked increase in the fragmentation and commodification of scientific inquiry.

Along with the generally intensified intrusion of commercial considerations into academic life, there has developed at large research universities like this one an increasingly corporate ethos; within departments and laboratories there has been a decline in the diversity of perspectives represented and an increase in the narrowness of technical specialization. Concurrently, the work of individual researchers and whole research groups increasingly proceeds in an atmosphere suffused with a sense of proprietary secrecy. Overall, this privatization and incorporation of science and technology makes it increasingly difficult for individuals and groups to engage in meaningful co-operation and, instead, pits them against each other in a helter-skelter, dog-eat-dog, competition for increasingly scarce research funds and for priority in the making and patenting of potentially financially profitable discoveries. Is it any wonder that corners get cut and data get hyped in the process?

President Vest has rightly noted that we here at MIT "have a responsibility that is even more profound than the development and transmission of knowledge." Included, as we see it, is the responsibility to recover, to exemplify, to uphold and to pass on to future generations, a commitment to a scientific worldview and value system predicated on a vision of science and technology in the service of humanity as a whole and otherwise consistent with the highest possible standards of personal and professional behavior.

One aim of this process well might be to curb the disconcertingly predictable tendency of scientific elites to automatically close ranks when allegations of academic impropriety are leveled at one or another of their members. In addition, something obviously needs to be done to protect and defend the rights and livelihoods of whistle blowers, so that they don't find themselves forced to choose between truth-telling and continuing to work in their chosen fields of scientific specialization.

But there is another, rather more subtle, facet to the whole issue of academic integrity to which it is necessary to draw attention - various "commonplace" or "routine" forms of institutional dishonesty. At MIT, these include stated policies versus actual practices regarding criteria for promotion and tenure, and serious questions regarding acceptance of "diversity." And what are we to make of the widespread and largely uncritical acceptance within this community of what amounts to a consistent failure to adhere to the academic equivalent of "truth in advertising" as far as the unit designations associated with certain subjects of instruction are concerned?

What difference does it make that some subjects of instruction exist at MIT for which the stipulated number of units listed in the *Bulletin* is more or less grossly inconsistent with the actual number of hours required in order for the average student to satisfactorily complete the assigned work? Why should we care if instances exist in which the actual imposed workload is reputed to exceed by a factor of two or more the officially-stipulated units? In the present climate, our concern is that the faculty, by turning a blind eye to the situation, teaches everyone involved (and most especially our students) a telling lesson about the place of truthfulness in the life of academic institutions.

We sincerely hope that sustainable policies, procedures and programs will be developed to deal with these issues. But precisely because ethical attitudes and conduct cannot be engendered by precept alone, policies and procedures, by themselves, will ultimately prove insufficient in resolving the present crisis. And precisely because personal and professional values are learned mainly by individual and institutional example, the additional necessity is for us to see to it that the spirit as well as the substance of academic integrity at its best becomes more prominent in the MIT ethos.

We encourage our colleagues to express their views on this critical matter to the members of the Committee on Academic Responsibilities as individuals, as well as through the pages of this *Newsletter*. If charity begins at home, then here is where academic responsibility starts.

Editorial Committee

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Next Issue

The next issue of *The MIT Faculty Newsletter*, the last for this semester, will focus on the year in review.

Summary analysis of the past academic year will include articles on the new administration, faculty committee reports (including a report to the faculty from the Context Support Office), and other pieces reflecting on past events. We'll also present Part Two of our excerpt of the Sarton Memorial lecture, and a continuation of the discussion on academic ethics.

If you would like to address one of these topics, or any subject of interest to the MIT faculty and the Institute, please send material to: ***The MIT Faculty Newsletter*, 38-160,** or to any member of the Editorial Board. Or you can reach us at our E-Mail address: **FNL@ZEISS.MIT.EDU.**

Ethics, Can We Talk About It?

Caroline Whitbeck

My experience in raising ethical issues among the faculty is that although some people and groups are receptive to open discussion of moral problems and issues, this is not uniformly true. The present attention to ethics by the MIT administration is likely to produce excellent reports on matters like the transmission of standards to students. If, in addition, we are to enhance our ability as a community to respond to moral problems in ways that are wise and fair, open discussion of ethical issues and problems must become a part of the faculty's common practice. We need such discussion to:

- keep moral standards clear in the changing circumstance that attend rapid development in science and technology;
- ensure that those standards are promoted in ways that are appropriate to current practices in a research field;
- foster the transmission of standards to students; and
- facilitate prompt attention to departures from the standards, before a problem grows to major proportions.

Resistance to such discussion often stems from fear of the discussion itself. I have found this fear expressed by many people whom I have independent reason to believe adhere to high moral standards in their own behavior. What is it that we fear?

One difficulty is the adversarial tone of many discussions and articles about moral problems and issues. This fosters the misapprehension that to discuss such matters is to take one "side" and defend it against the other "side" and have an exchange marked by accusations and blame. The idea that discussion might take the form of joint problem solving is difficult for some to envision, although it seems quite natural to others.

Another impediment to open discussion is the belief in some quarters that there must be a unique correct response to every moral problem, and that every right thinking person will immediately see it. To want to discuss the problem and educate oneself about it, is then taken as evidence that one is immoral or stupid.

A third problem, is that there is some tendency for individuals to become identified with a particular moral issue. Of course, we do differ in our judgments about which ethical concerns are most important and what problems are the most urgent. What is false, however, is that moral concerns must be in competition with one another (except in the trivial sense that all matters compete for our limited time and attention). On the contrary, usually our ability to address one sort of problem in a responsible, constructive, and compassionate way enhances our ability to respond to others.

Another impediment to open discussion is the belief in some quarters that there must be a unique correct response to every moral problem, and that every right thinking person will immediately see it. To want to discuss the problem and educate oneself about it, is then taken as evidence that one is immoral or stupid.

Discomfort with fallibility also inhibits open discussion. I am struck that there is enormous difference among groups on this campus in the amount of shame that attaches to taking something back. Graceful retraction seems to be particularly valued and encouraged within groups of designers for whom brainstorming and discarding ideas is a regular part of their procedure. However, in other places being wrong in public carries a tremendous loss of face. When people cannot easily take something back, it is very difficult to have an open discussion of moral questions.

A final barrier to discussion of moral matters (and a consequence of the lack of it) is the absence of a common vocabulary on moral matters that would enable us to recognize when we are agreeing, disagreeing, or addressing different subjects.

I will illustrate these points with my experiences, first, of faculty responses to a scenario concerning assignment of credit between faculty and students, and second, in discussions with students and faculty on the subject of cheating.

In the spring of '89 discussion with graduate students about our new ethics courses showed that the question of standards of fairness in apportioning credit is an important topic on which they often feel powerless to get answers.

I initially sent to the heads of all of the science and engineering departments a brief scenario which raised questions about standards of fairness in joint authorship by graduate students with faculty. The scenario involves "Generic Graduate Student," whose advisor, Prof. Mentor, has promised to see to the publication of Generic's master's thesis. Generic hears nothing more until an article appears with Mentor's name first and some errors due to Mentor's rewording of several points. Questions were attached to the scenario. These included:

"Which, if any, of Mentor's behavior was wrong and what is the gravity of any offense?

"Do members of your department have differing views on the first question? Do their answers vary with their previous disciplinary orientations, the conventions used by the journals in which they publish, the nation and period in which they received their own graduate training, etc.?

"Are there standards covering a case such as this that are generally accepted in your department? How would a new faculty member come to know them? How would a new graduate student?"

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I explained my educational purpose, namely, to have good information about the standards and practices in MIT departments to give to students when we discuss credit in our courses.

Responses varied. One head of an engineering department immediately held a discussion of the case and wrote to me about it. The head of one of the departments in the School of Science wrote "not of interest to us" across the scenario and sent it back. (I then asked a member of that department to find out how such a matter would actually be handled, which he did.) In the end, most of the engineering departments held discussions of the issue, but, despite the example of a timely response of the head of one science department who had even previously presented a similar scenario in his own department, most departments in the School of Science did not. Interviews were conducted with individuals in those science departments, to complete our information for students. Later I wrote to the heads of the HASS departments with the same request. One department responded.

Differences in the discussions that did occur illustrate a range of responsible ways of addressing the issue of credit, and differences among disciplines and departmental "cultures," although everyone agreed all authors should see a manuscript before it is submitted for publication. There was also considerable differences within and among departments in practices for assigning authorship. For example, a member of one engineering department said he gives students a written statement saying that usually, but not invariably, any publication resulting from the master's thesis will have the advisor's name first, any publication resulting from the doctoral dissertation will have the student's name first. My findings indicate that virtually all members of his department agreed with this "default policy" on authorship (although others did not have a written statement) because the practice in that field, or at least that department, is to give a student a topic for a master's thesis only after the faculty member has "seen through" the entire problem to ensure that the student will not come up against an insuperable difficulty. This circumstance would justify having Mentor's name first and shifts the problematic point to Generic's ignorance of the advisor's authorship policies.

In contrast, in the department that showed the greatest range of practices among its members, one faculty member said that he hates to write up research so whoever in his group comes up with the first draft of a paper secures the first author position, and his students all know his policy. The discussion in this department was vigorous and comprehensive and one of a minority of discussions in which the special vulnerability of students in questioning faculty practices was discussed. In order in part to relieve the students of the burden of figuring out the variety of practices of different members of the department, this group held a second discussion to which graduate students were also invited.

Some faculty were more defensive in their response and wanted evidence of the exploitation of graduate students as justification for discussing the problem further (as though the request for discussion were a form of accusation, and the clarification and justification of standards were not a sufficient reason for discussion).

My interest in the cheating question stemmed from complaints that I had heard from students about cheating (mainly to the effect that the faculty did not do enough to stop it). I participated in many discussions with faculty on the subject including one large meeting in which nearly half of those present wanted to disallow further discussion because discussion would "poison the water," as though to discuss the problem would be to accuse all students of being cheaters! It seemed important to test that point and to get an opinion from a broader sample of students, so I developed a brief degree of agreement questionnaire, using statements gathered from students and faculty. This questionnaire was answered anonymously and voluntarily by students in a large senior engineering subject.

The results (which I am happy to send to faculty who would like them) indicate that most students do not cheat and that existing cheating is disheartening most students. Homework policies appeared as particularly problematic. In particular, about 90% of the students agreed or strongly agreed with the statement "The unauthorized use of solutions for homework problems will continue as long as faculty assign problems from previous years." These data may be useful to the faculty in establishing subject-specific policies to curtail cheating, or homework policies that make cheating on homework a non-issue. (This was accomplished recently in 6.001 by giving all students the same access to solutions from previous years by putting the solutions on Athena, and by grading, not on the student's answer, but on the quality of the students' reasoning and approach to homework problems.)

The faculty must take the responsibility in extending and strengthening our discussion of ethical issues and problems, if discussion is to occur whenever and wherever it needs to. It is important that we do the work to overcome the barriers to discussion and collectively take responsibility to guarantee that discussions are carried out in ways that do not realize people's fears! That will undoubtedly take time and attention, but it will also improve our working environment and prevent situations that will ultimately prove much more burdensome.

Serving International Industry An Opportunity for MIT

Markus I. Flik

Compared to other research universities, MIT enjoys unique relations with international industry. International companies sponsor research at MIT and endow faculty chairs; they hire MIT graduates and take advantage of the services of our Industrial Liaison Program.

Both in Congress and in the media, MIT was criticized for the intensity of its relations with international industry. It is feared that MIT is selling out critical technology to competitors in the increasingly tougher international market.

MIT must decide how to react to this criticism. Should it reduce, or at least freeze the level of its international involvement?

The answer is no. On the contrary: MIT must *intensify* its relations with international industry. Serving international industry is an opportunity for which MIT is uniquely equipped. Industry is the single most important customer of MIT.

Industry hires our graduates, and it transforms our research results into products that improve human life.

Industrial activity has become a global enterprise. In contrast to the multi-national companies already existing before the Second World War, today's global companies not only sell their products globally, but they also perform research and development worldwide and produce their products on several continents.

MIT's single most important customer has gone global. If MIT wants to continue to serve industry as effectively as in the past, then it must become a truly global university. MIT faculty already interact with their colleagues all over the world, and MIT students come from all continents. To become a truly global university, MIT also must intensify its relations with international industry.

Research Sponsorship

MIT must increase the volume of its research support from international industry. At present, the federal government supports 75% of on-campus research expenditures, American corporations 12%, and international corporations only 3%. In times of decreasing federal support for research and education, these additional funds will help to maintain the excellence of research and education at MIT. Increased support from international industry will ensure the impact of MIT research results through effective technology transfer. It is MIT's role to work on the toughest and most important technical problems facing mankind. It can only fulfill this role if its results are applied worldwide.

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Faculty-Industry Interaction

Mutual visits among international industry executives, scientists and engineers, and MIT faculty members should be intensified. These interactions will give MIT faculty an opportunity to understand research problems posed by industrial activity worldwide. It is not clear that the most important applied research problems of our times are those posed by U.S. industry.

Employment of MIT Graduates

International industry should be encouraged to continue to recruit at MIT. Alumni working in global companies will provide a global network for MIT which will ensure its global impact. The language problem will become less important in the future with large European companies already switching to English as their main language and English becoming the single most important language in the common market after 1992. For our graduate students, MIT can increase their competitiveness on the global market by reintroducing a foreign language requirement for Ph.D.'s. For many years this had been a firm part of our doctoral programs, and for good reasons.

Dissemination of Research Results

The Industrial Liaison Program should be even more active than in the past in providing access to MIT research results for international industry. Only if our research results

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glow. But underneath, when viewed through the prism of analysis and insight, it diverges and spreads out into the many different colors of the rainbow. Let us now explore some of the ways in which this metaphoric prism has unfolded through history.

Over the centuries, communities or groups of people, networks, and loose associations have formed around human endeavors. This has been the case with science, no differently than with any other endeavor. From Antiquity on, groups or cliques have worked in science, advancing knowledge through direct collaborative efforts and frequently through shared sources of information. The Pythagoreans were a secretive group of mathematicians working almost in Masonic style on some of the fundamental problems of mathematics and science. Just who these people were and what brought them together are unknown. It is clear that they represented a closed group, neither diverse nor inclusionary.

One of the criteria for admission reportedly involved an examination to determine whether the candidate's head shape and facial expression complied with certain established standards or requirements. Although we do not exactly know what these standards were, there can be little doubt that they generated homogeneity in the ranks. Numbering around three hundred, the group worked on a body of philosophical and scientific problems that have come down to us in the clear and precise form that we call Pythagoreanism. More is known about the body of literature itself than about the individuals or the group that created the work. Here stands an example of a tightly conceived body of problems and approaches to solution, defining a community of scientists. The approaches were sometimes collaborative, sometimes not.

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The notion of scientific community broadened as modern science emerged in the fifteenth, sixteenth, and seventeenth centuries. It came to include anyone involved in scientific communication - the writing of letters or commentary, or the actual performance of scientific research. Yet within this expanded definition, smaller communities developed around the various branches of science. The original organic, if somewhat diffuse, whole became fragmented into a series of separate disciplines. By the sixteenth century, there were at least two strong traditions of scientific endeavor; one in astronomy surrounding the work of Copernicus, Kepler, and Galileo, and another in anatomy and physiology centering on the work of Vesalius and Harvey. These areas of scientific activity produced a shared body of scholarship that focused practitioners from different places on the same fundamental problems of nature. The people who participated in formulating theoretical frameworks for each area, who posed research questions, who probed for solutions, and who ultimately came full circle to pose new questions, constitute what might be called a cohesive scientific community.

A lot can be learned about a community simply by perusing a list of names. The names of Copernicus, Galileo, Brahe, and Kepler suggest that, during the Renaissance and afterwards, contributions were made by individuals from various countries, of different nationalities. The names of Vesalius, Descartes, Huygens, and Newton further confirm this impression. Geographic boundaries became less important as people like Copernicus, who traveled from Krakow to Padua, crossed national borders to acquire new knowledge and expose themselves to innovative ways of thinking.

Scientific ideas traveled too, following the main current of intellectual flow. With the general revival of the arts and letters, science moved northward from Renaissance Italy to England and elsewhere, having been centered during the Middle Ages largely in Arab-speaking regions. No one place served as a focus or center of activity in the emergence of modern science. No one people monopolized the work. No one religion was dominate. Many nationalities were included. Science flourished in Italy, France, and England, and the scientific community consisted of Italians, Poles, Germans, French, Dutch, and English. Protestants and Catholics were represented amidst the ferment of the Protestant Reformation.

What is striking, however, about any list of major contributors in the development of modern science - names like Descartes, Newton, Boyle, Leibniz, Torricelli, Brahe, and Vesalius-is the conspicuous absence of Jewish names. The scholarly tradition emanating from Moses Maimonides, the medieval Jewish philosopher and author of medical treatises, suggests that there ought to have been Jews in the group. But such was not the case. Their absence is explained partly by socially exclusionary practices that kept them out of certain

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activities and academies.

Another factor was cultural, specific to the Hebrew intellectual tradition itself. The study of nature and of natural phenomena was different from, in some sense inimical to, studying the Torah. Hebrew scholarship centered more on theology than on nature. Jewish contributors at the level of a Kepler or a Newton did not appear in the scientific community until the late nineteenth and early twentieth centuries. Before 1600, only a few Jewish philosophers took up natural history and some astronomy in connection with the interpretation of holy writ and the reckoning of the calendar. Minimally involved in the main currents of scientific research prior to the Renaissance, Jews were a small presence too in the seminal developments that took place in Europe during the fifteenth and sixteenth centuries. The *Dictionary of Scientific Biography* lists a mere handful of scientists with Jewish names or with Jewish backgrounds from this period.

The eighteenth century witnessed the beginnings of a trickle of women into the practice of science. Like Jews, women had been absent from the roster of fifteenth-, sixteenth-, and seventeenth-century scientists. By the middle of the eighteenth century, a few had begun to engage in scientific study and, in some cases, research. These women wrote and, in certain instances, published works in mathematics, astronomy, and natural history. Names like Madame du Chatelet, Caroline Herschel, Marie Agnesi, and Sophie Germain come to mind. With the advent of such women, one might note the ongoing geographic diversity in the female ranks of science. Du Chatelet translated crucial aspects of Newton's work into French under the influence and guidance of Voltaire, who himself could not understand the technical results. Herschel helped her brother in astronomy. Agnesi and Germain engaged with men in provocative, advanced discussions of mathematics and mathematical physics.

Most often a woman's route into science was through progressively-minded male mentors - a father, a brother, an uncle, a lover. Sometimes, as in the case of Sophie Germain, it was through academically impersonating a man and dressing up her scholarship in men's clothing by submitting her assignments under the name of a male student, Monsieur Leblanc. Believe it or not, there are stories of women masquerading as men their entire lives in order to carry on scientific and other careers that otherwise would have been closed to them. Perhaps the most notorious example was Dr. James Barry, whose intellectual talents were recognized when she was a little girl and whose guardians dressed her up as a boy and shipped her off to study natural philosophy and other subjects at the University of Edinburgh. After taking a doctor of medicine degree in 1812, she joined the British Army and served as a medical officer all over the world, becoming the second-highest ranking medical officer in the colonial military establishment. The truth about her sex was not discovered until after her death.

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If Francis Williams and other blacks educated in eighteenth-century Europe were well versed in the work of Newton and others who were in the vanguard of scientific thinking, the same could not be said for many Americans. American scientists of the time were hard put to understand much of Newton or Leibniz, Euler, Lagrange, or Laplace. But, even though they were far less advanced than their European counterparts, some Americans were members of the Royal Society of London, and in general part of that scientific community, even if only as foreign or corresponding affiliates. The eighteenth-century American statesman of science, Thomas Jefferson, found himself in the position of having to defend his countrymen against the accusations of the Comte du Buffon and other Europeans, who charged that nothing of cultural or biological worth existed in the New World. In his *Notes on the State of Virginia*, Jefferson praised the mathematical and astronomical work of Benjamin Banneker as worthy of serious attention. Banneker, a free black living in Maryland, did not attend or have an affiliation with a university, but he was widely recognized, within national borders, as a leading American scientist of his day.

During the 1790's, Banneker pursued scientific research, published almanacs, and calculated astronomical predictions. Alongside his publications on science, he spoke out on the issue of the equality of blacks. He told Jefferson that his own accomplishment was proof that blacks did not possess inferior minds and that his work should pave the way for emancipation of the slaves. Banneker's case is an example not only of the early participation of American blacks in science, but also of an early American scientist who assumed a moral

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voice in science. Jefferson is thought to have sent a letter to the Marquis de Condorcet in Paris in the hope that Banneker's work would be brought to the attention of the Academie des Sciences. That didn't happen, however, because in 1794 Condorcet became a casualty in the French Revolution. Yet Banneker had already, in 1791, served as part of the team of surveyors and engineers who contributed to the layout of the city of Washington.

Free blacks constituted the only group of blacks in America who had even a meager chance for exposure to educational opportunity and the scientific literature, and, by extension, possibly to engage in scientific work itself. It was through the efforts of the free black population that many black educational and religious institutions were able to grow and flourish in antebellum America. Free blacks not only struggled for legal emancipation, they also were involved in liberation efforts, through the underground railroad, through marriage, and through purchase. In addition, following the passage of the Fugitive Slave Law, they all had to be concerned about maintaining their own personal freedom. For many, scientific work was a mere dream that they could only realize under more favorable circumstances and in a more congenial racial climate.

By the start of the Civil War, no blacks had engaged in pure science as such since the time of Banneker at the end of the previous century. They were consistently active in the field of invention, however, as attested to by the careers of Thomas L. Jennings, Henry Blair, George Peake, James Forten, Norbert Rillieux, and others who acquired patents.

By the middle of the nineteenth century, American scientific institutions and organizations had begun to develop. White American scientists, working at a level of achievement and sophistication comparable to that of Banneker, were establishing impressive institutional structures on which their sons - and by now some of their daughters - could build and from which they could benefit. American science enjoyed the participation of educated individuals who were beginning to understand the works of Europeans in the vanguard of modern science.

Only with the Emancipation Proclamation of 1863 did any significant participation of blacks in the social, cultural, educational-and scientific-institutions of the country become at least possible. The Freedmen's Bureau, set up in 1865 to provide opportunities for former slaves and poor white men and women, was one of the first formal mechanisms by which blacks as a group benefited educationally and professionally.

In the 1850s, Harriet Beecher Stowe was writing her *Uncle Tom's Cabin*, hoping to contribute to the emancipation movement. Around the same time, Darwin was publishing his *Origin of Species*, and Alexander Bache and others of the so-called Lazarroni were planning the National Academy of Sciences. The American Association for the Advancement of Science had been founded in 1847, and, in 1861, William Barton Rogers obtained a charter and a plot of land in Boston's Back Bay to develop "a School of Industrial Science," an operation we now call the Massachusetts Institute of Technology.

Only with the Emancipation Proclamation of 1863 did any significant participation of blacks in the social, cultural, educational-and scientific-institutions of the country become at least possible. The Freedmen's Bureau, set up in 1865 to provide opportunities for former slaves and poor white men and women, was one of the first formal mechanisms by which blacks as a group benefited educationally and professionally. At the time, it was indeed the only way for most blacks to begin to participate minimally in scientific activity. By 1912, almost fifty years after the end of the Civil War, over sixty black colleges and universities had been set up, providing blacks with an essential start in their pursuit of advanced degrees.

In 1876, the first black Ph.D. from an American university, Edward Bouchet, received his degree in physics at Yale University. He was one of the first recipients of any color to earn the Ph.D., the first in America having been awarded just ten years earlier. But it was not really until the turn of the twentieth century that a handful of blacks began to enter the scientific fields. Among these people come to mind Charles Henry Turner, George Washington Carver, Ernest Everett Just, St. Elmo Brady, Elmer Imes, Julian Lewis, and a little later, Percy Julian and Charles Drew. This cohort represents the first group of black scientists who received Ph.D.'s from major white universities, pursued science at the research level, and published in the leading scientific journals of the day. Prior to the Second World War, their professional lives were almost exclusively tied to black colleges and universities.

End Part One

[For a complete text of the Sarton Memorial Lecture, write *The MIT Faculty Newsletter*, 38-160.]

Alumni and Alumnae as Part of the MIT Community

William J. Hecht

MIT's alumni/ae body, 90,000 strong, constitute a significant and under-involved resource for the Institute. Many are intimately involved with MIT as faculty, staff, Corporation members, or members of visiting committees; some 5,000 volunteers make policy for and execute the work of the Association. But too many alumni/ae perceive their participation as strictly financial; they think that MIT doesn't want to be bothered with them. This large group of skilled, energetic, well-connected, and presumably well-educated people represent an international network of advocates and colleagues for us.

Alumni/ae want closer involvement with MIT; many demand it as a condition of their continued support. The "Campaign for the future" raised the expectations of numerous volunteers and donors with respect to their MIT ties. The alumni body represents an unusual cross section of many of the leaders and decision-makers in the world today. They are university faculty, industrial leaders, technologists and scientists, public sector professionals, administrators, doctors and lawyers, and elected public officials. In many foreign countries they represent a substantial section of the leadership of society.

My goal is to expand alumni/ae involvement without overburdening an already overburdened faculty. Realizing the existing substantial faculty/alumni contacts through former students, Alumni Association and Resource Development activities, etc., how can we do more - given my admission of your overcommitment?

MIT alumni/ae figure in every major industry worldwide, and therefore can serve as valuable connections and references. Would wider contacts in a company or industry be helpful? You can use alumni/ae contacts as local connections to companies on issues you are pursuing. Alumni/ae can help with seminar presentations, over IAP, through plant tours for students, and as mentors. Are there career questions students ask that alumni/ae can assist in answering? Seek out experienced alumni/ae to answer them, especially those with non-traditional careers.

The opportunities are limited only by your imagination and the ability of a given alumnus or alumna to help. Many alumni/ae view this kind of request as a genuine opportunity to be engaged, not as a burden. They will respond to a request that goes beyond the need for financial support. Significant evidence exists that involvement leads to substantially increased levels of alumni/ae giving. The alumni/ae connection, like splitting wood, warms twice.

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Let me cite specific examples of ongoing activity that could be replicated with more faculty involvement. Several departments, with our support, are holding informal receptions at professional society meetings for their alumni/ae, with particular emphasis on those who hold graduate degrees. One department has successfully engaged a number of local alumni/ae in career counselling and mentoring for its graduate students. Many departments seek non-faculty alumni/ae as seminar speakers. Individual faculty members have spoken to alumni clubs around the world. Many are involved in the Association's annual Technology Day and Reunions. Significantly, many of you have written for *Technology Review*.

There are other activities of equal import. Several alumni clubs are enlisting local alumni/ae in the K-12 education system to assist in the push for scientific literacy. Alumnae groups have visited high schools encouraging women to continue pursuing science and math as sound preparation for all careers, not just science and engineering. Faculty should engage alumni and alumnae broadly on an array of topics to continue alumni/ae education and enlist them in public debate on issues of national and international importance. Recently we ran a series on the work of the MIT Commission on Industrial Productivity; our last Technology Day focused on the science and policy issues of global warming.

The opportunities for increased alumni/ae involvement are many and await your initiation. MIT is the envy of many institutions because our alumni/ae are more engaged. Yet faculty, administration, and the Association must do more to capture larger shares of their interest, commitment, and subsequent support. How might we raise a series of broad social issues for public debate among our alumni/ae? How do we enlist our alumni/ae's broad public support of science and technology to enable our country to continue to be competitive? We must engage the alumni/ae in the debate about the need for breadth and depth in an undergraduate education. We should engage alumni/ae in the issues surrounding how public decisions are made about technologically-based decisions. We must inform MIT alumni/ae and the nation at large about emerging technological issues and the economic and ethical impacts. What new mechanisms can we create to link productively with our alumni/ae?

My office, the staff of *Technology Review*, and our volunteers stand ready to help connect you to the MIT alumni body. How can we engage the faculty more effectively? What can we do through our alumni body to help? We intend to keep up the vigorous pursuit of financial resources, but can do much more, and stand ready to do so.

Biology Requirement Vote Expected At May Meeting

(Continued From Page 1)

while the other third will focus on a particular area of application. The application area may be integrated into the core or presented as a focused final third of the semester.

Professors Paul Matsudaira and Brent Cochran are currently teaching a pilot form of the proposed course. The "flavors" are projected to include medical genetics; physiology; neurobiology; development; environmental biology; and biotechnology. Thus engineering students might, for example, gravitate toward the physiology, neurobiology, or biotechnology options. Not all flavors would be offered each year, but students would have four years to satisfy the requirement.

To keep the General Institute Requirements (GIRs) reasonable, the Science Distribution requirement will be dropped from three courses to two, one within the students department and one outside. Unlike the other GIRs, student's will be able to place out of the 7.01 requirement through advanced standing.

The proposals were received at the faculty meeting with considerable enthusiasm; Professor Thurow and others even expressed a desire to take the courses (in the summer). The Undergraduate Association representative reported that the student body appeared to be equally divided for and against the proposed Biology Requirement.

The final vote on the resolutions will take place at the May faculty meeting.

Table 1

Institute Biology Course - Core Material

All versions of the course would include:

(1) the **Definition of Genes** (operational and theoretical, genetic, and molecular biological);

(2) **Biological Coding** and **Information Transfer** (DNA to RNA to protein);

(3) consideration of the **Structures of Proteins** and their universal roles as the structural and catalytic units of living organisms;

(4) the concepts and mechanisms of **Biological Specificity** (recognition, binding, and catalysis);

(5) the generation and utilization of **Energy in Living Systems**;

(6) the **Structures of Cells**, the basic units of life, and their adaptation to a variety of tasks;

(7) the **Regulation of Biological Systems**;

(8) the development and organization of **Multicellular Organisms**;

(9) **Biological Diversity** and **Natural Selection** in the **Evolution** of life.

Table 2

Institute Biology Course - Elective Material

(1) Medical Genetics
Genetic Diseases; Recombinant DNA/Gene Mapping; Prenatal Diagnosis; Gene Therapy; Cancer

(2) Physiology
Development and Reproduction; Muscle and Skeleton; Endocrinology; Immunology/AIDS; Vascular Disease

(3) Neurobiology
Nerve Cells as Electrical Devices; Neuronal Specificity; Vision (Physiology/Molecular Biology); Nerves-Muscles-Synapses

(4) Development
Pattern Formation; Morphogenesis; Tissue Development; Fertilization; Sex Determination

(5) Environment
Population Genetics; Biological Diversity; Ecology - Natural Selection; Toxicology - Mutagens/Carcinogens

(6) Biotechnology
Cloning and Expressing Genes; Protein Engineering; Crop Plant Engineering; Bioreactors

Serving International Industry
An Opportunity for MIT

(Continued From Page 7)

are applied by international industry can we have a truly global impact. Nothing secret is given away in this process. There is no classified research at MIT. In fact, MIT faculty are discouraged from entering research contracts which limit their right of publication. MIT faculty have published their results in international journals for many years. Improving the access of international industry to our results simply accelerates the process of worldwide dissemination of MIT research results.

There are three groups that will benefit considerably from intensified relations of MIT with international industry.

The employment opportunities for MIT students are enhanced through good international industry relations. Our students will be more competitive in an increasingly international market for technical professionals.

MIT faculty will benefit from the increased volume of sponsored research achieved through intensified international industry relations. These relations will also ensure a truly global impact for the research work of MIT faculty.

Surprisingly, American industry also will profit from a global orientation of MIT. It will encourage them to interact closely with MIT to make use of its research results and graduates to the same extent international industry does. American industry will have a truly global institution at its disposal which is on top of industrial developments worldwide.

Proposed Action

The Industrial Liaison Program should appoint for each MIT department one of its officers as a consultant to the department. The consultant will work with individual faculty to build relations with national and international companies in those industries in which the faculty member's research results are applied. The targeting of specific industries for each faculty member appears to be the most promising avenue to increased industry research support. Initially, the administration should provide ILP with the necessary resources. After one year, the consultants to the departments should be paid out of the overhead of research grants acquired through their assistance.

Serving international industry is an opportunity for which MIT is prepared like no other research university in the world. The global competition among research universities is becoming tougher. In order to maintain its present leadership, MIT must take advantage of the opportunity to serve international industry.

Authors

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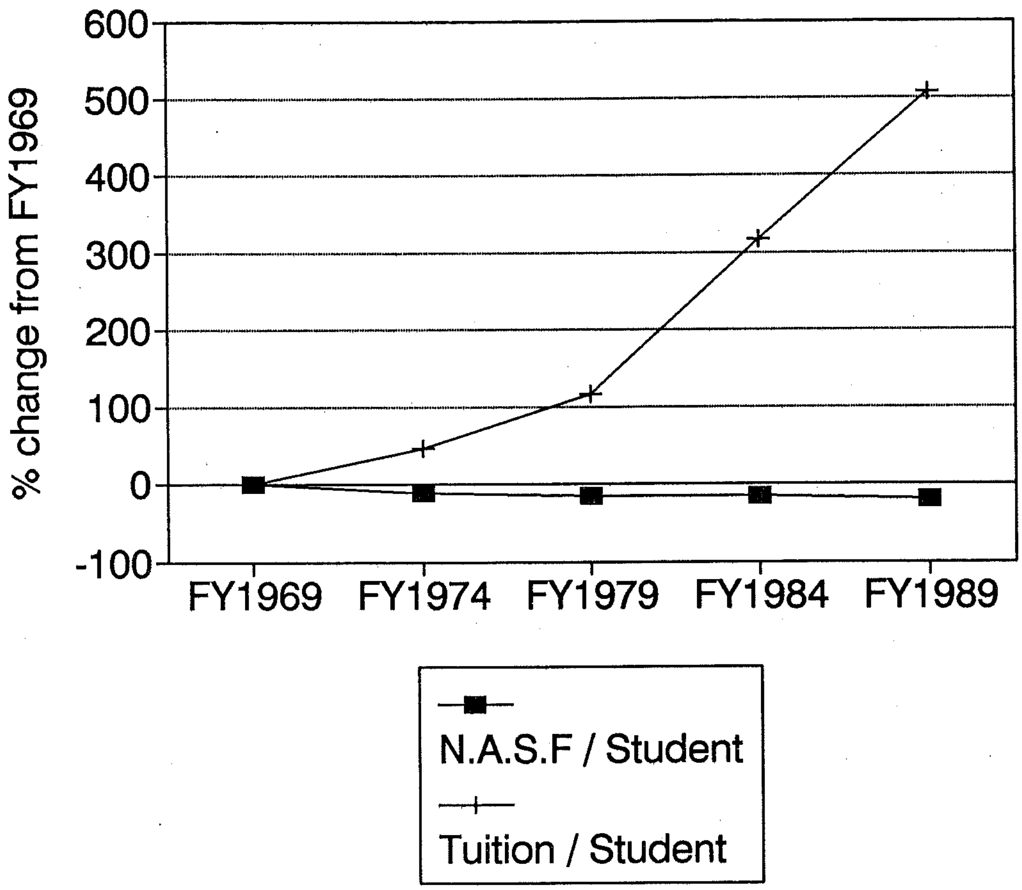
M.I.T. Numbers

Classroom Space Compared To Tuition and Related Revenue



	FY1969	FY1974	FY1979	FY1984	FY1989
Total Students	7,764	7,888	8,881	9,577	9,500
N.A.S.F.*	146,000	133,000	143,000	154,000	146,000
Tuition/Related Revenue ($000)	$18,109	$27,004	$45,028	$93,496	$134,539

*Net Assignable Square Feet

Source: **MIT Factbook**; Prepared by the Planning Office, June 1990.

Letters

The Baltimore/Imanishi-Kari/ O'Toole Affair

To The Faculty Newsletter:

As this affair is developing, there can be no doubt that it will cost the academic community dearly in its standing with the public on whom it depends for its sustenance. Without commenting directly on the conduct of the individuals involved, it is still possible to draw some much-needed lessons on how to avoid such situations in the future.

The first lesson is to keep our mouths shut until we know the facts. Hard as it is to know the facts in a purely scientific investigation, it is clearly much harder in such cases to know who is speaking the truth and who is lying, or perhaps just trouble-making.

The second lesson is to avoid putting our names on the papers of our young colleagues, even if we have made some contribution to the work, such as suggesting the line of research. This is a very common practice at MIT, where thesis supervisors more often than not place their names after (even before!) those of their students or postdocs who actually carried out the research. A name on a paper implies responsibility for its contents. We certainly ought not to appear as authors of work we have not watched carefully enough to know whether or not it is correct. This was put very well in an editorial in the *San Francisco Chronicle* of March 25:

"There is no suggestion here that Baltimore, who won a Nobel Prize for medicine in 1975, was a participant in scientific fraud. But the case is a classic example of what happens when senior scientists lend their names to research performed by others.

"If they want to snitch a share of unearned glory from their juniors, the least they can do is to make sure the work is correct."

The final lesson is to stop claiming that, as scientists, we have some special right to be investigated and judged only by our colleagues, and not by the people who are paying the bills. The public is willing to pay the bills because of the perceived benefits, not because it believes that scientists have some higher right to pursue their intellectual interests at public expense. In this case, the in-house investigations failed to find out what really happened. To continue to claim that, even so, public authorities had no right to look more closely, will cause the scientific community much more damage than due to this one case.

William F. Schreiber
Professor of Electrical Engineering
Emeritus

To The Faculty Newsletter:

Instead of setting up courses (or whatever) in ethics - and thus diluting real intellectual activity still more - all the president of any university needs to do is:

1. Declare that signed authorship of papers is restricted to those who know the contents in detail, with dismissal for violations.
2. Require that the chief academic officers read carefully the full history of the Hiss case, to learn that even the worst politicians can be right and the best academics wrong.

David Frisch
Professor of Physics
Emeritus

To The Faculty Newsletter:

I have just received my March 1991 issue of the *Newsletter*. The Editorial Board should be congratulated for another excellent issue. I am particularly impressed with the articles by Greytak, Hynes, Siebert, and Groisser on the new biology requirement. This careful and clear setting out of the issues growing around this important new initiative will help the faculty enormously in understanding and responding to the various alternatives presented.

David H. Marks
Professor and Department Head
Civil Engineering

To The Faculty Newsletter:

Though not a member of the faculty, I very much enjoy the *Newsletter* when I see it.

I wonder if you would be willing to send me a copy of the most recent issue, and I wonder if it would be possible to be on the distribution list.

The *Newsletter* is one of the most interesting and informative MIT documents that comes my way, and I always enjoy reading it.

John Jacoby
Office of Communications
Resource Development

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In an attempt to accommodate all members of the MIT community, the *Newsletter* now accepts subscriptions. See the back page of this issue for details. [We sent Mr. Jacoby a copy of the most recent issue!]

Is Anyone Out There?

On the back page of last month's issue we wrote: "The administration has agreed to provide funds for the production and distribution of the *Faculty Newsletter* **provided that a faculty editorial board of not less than nine members agrees to take responsibility for the operation of the *Newsletter*.** This condition is intended to ensure that the *Faculty Newsletter* is truly representative of faculty concerns and interests. We are now soliciting memberships on the *Newsletter* Editorial Board for academic year '91-'92. Ideally, we would like to field an eighteen member board, so as to achieve broad representation of the faculty and to share the (not too onerous) burdens more equitably. If you are ready to do your share to maintain our communications channel, either contact one of the present Board members, send an E-Mail note to us at FNL@ZEISS.MIT, or fill out and mail the coupon below."

There are 988 faculty at the Institute. We received an embarrassingly small response! Faculty members who want to maintain this channel of communication must take responsibility for it. If not you, who?

I would like to discuss the possibility of joining the Editorial Board for the academic year '91-'92. Please have someone on the Board contact me.

Name____________________ Department____________________

Address____________________ Phone____________________

Mail to: *The MIT Faculty Newsletter*, 38-160.

The *Faculty Newsletter* is mailed without charge to faculty members, professors emeriti, and members of the Corporation. The total press run is 2200 copies per issue with nominally eight to ten issues per year. We would be pleased to make the *Newsletter* available to other interested parties at the incremental printing and mailing cost of $15/year (on campus) and $20/year (off-campus). If you would like to subscribe, please fill out the form below and include a check payable to *MIT Faculty Newsletter*.

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