The MIT Faculty Newsletter

"What's Wrong With MIT?" Will Have to Wait

Despite calls in the last *Faculty Newsletter* for articles dealing with the question "What's Wrong With MIT?", the Editorial Committee for this issue, sensing the mood on campus, decided that focus on our problems would not be helpful at this time. We dedicate our editorial (Page 3) to those who were looking forward to a list of problems.

The articles in this issue reflect the normal stream of concerns at the Institute, without editorial prompting. It is interesting to note that the resulting unbiased selection illustrates a clear theme: the desire to change the status quo to make things better.

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EXCLUSIVE!!!

Upon request of the Editorial Board of the *Faculty Newsletter*, Prof. Phil Sharp agreed to provide us with an open letter to his faculty colleagues at MIT.

Prof. Sharp's "Statement for the *Faculty Newsletter*" is printed on Page 4.

COMMITTEE REPORT
A Proposal to Extend the Examination Period to 5 Days
W. M. Siebert

At the Faculty Meeting on March 21, an *ad hoc* faculty committee (composed of Fred Greene, Leon Groisser, George Koster, Win Markey, Jim Munkres, Frank Perkins, and myself, together with the Registrar, David Wiley) proposed various changes in the Institute calendar designed to extend the number of days scheduled for final examinations at the end of each term. A motion to change the Faculty Regulations accordingly was moved, seconded, and briefly discussed; a vote will be taken at the April Faculty Meeting. Since changes in the Faculty Regulations - particularly those which affect the calendar - are a serious matter, and since not everyone manages to get to Faculty Meetings, I am using the *Newsletter* to distribute more widely a summary of our proposal and the reasons why we support it. For more detail, please refer to the Announcements of the March or April Faculty Meetings.

Briefly, the goal of the proposed changes is to relieve a difficulty that afflicts a significant minority of MIT students and faculty. With only 4 days currently allowed for examinations in the fall term and only 3 in the spring, students with multiple exams (1600 students had three or more exams last spring) have little time between exams to catch their breath or prepare for the next one. And conflicts between scheduled exams have become so common that last spring about 100 faculty were required to make up and

A Laboratory for Developing Musical Thinking, Hearing, and Appreciation
Jeanne Bamberger

Having taught introductory music courses both here and elsewhere over a number of years, I found myself bothered by several issues that would not go away. My goal was to help students, especially those who are primarily listeners, to hear and to engage more intimately the "workings" of complex musical compositions. But simply listening to recordings and talking about them didn't seem to be good enough. Moreover, I believed there should be some way of appropriately relating the arts and humanities, on one hand, with engineering and science on the other. I thought of it as making connections between what was going on in my classes and what our students are doing the rest of the day. And finally, it seemed that there should be a better way of using the computer as a medium for learning, not just for teaching.

It seemed clear, for instance, that students needed hands-on experience through which they could experiment with the basic materials of music - pitch and time relations. I imagined a Lab where students could, for instance, design and build simple musical structures while at the same time inquiring into and developing their own musical intuitions - what they knew how to do but couldn't yet say. It should be an environment where students could work within design constraints that generated challenging, even puzzling situations that would bring them into active contact with the

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Authors

Jeanne Bamberger is Professor of Music and Theater Arts.
Catherine V. Chvany is Professor of Foreign Languages and Literature.
Louise Dunlap is Senior Lecturer, Department of Urban Studies and Planning.
Henry D. Jacoby is Professor, School of Management; Chair of the Faculty.
Willard R. Johnson is Professor of Political Science.
Louis Kampf is Professor of Literature.
Daniel S. Kemp is Professor of Chemistry.
Margaret MacVicar is Professor of Physical Science; Dean for Undergraduate Education.
Fred Moavenzadeh is Leonhard Professor of Civil Engineering.
Peggy Richardson Enders is Assistant Dean for Curriculum Support; Coordinator, Context Support Office.
W. M. Siebert is Ford Professor of Engineering.

Editorial

What's Wrong With MIT?

Ted Williams spent more time in the batting cage than anyone else on the Red Sox. Johannes Brahms waited years before he was convinced that his first symphony was good enough for public exposure.* *The Faculty Newsletter* uses far more space discussing what is wrong with MIT than what is right. The last issue (II,4) focused on "a variety of topics of particular *concern* to the MIT faculty." The editorial even discussed the "malaise" affecting MIT. Several of our colleagues responded to that much as the American public responded to Jimmy Carter's famous Camp David speech.

The easy answer, of course, is to point out that *The Faculty Newsletter* can only print materials that are submitted. We are not so inundated with submissions that we can change the tone of an issue by artfully biasing our choices. Time is very precious at MIT, and we only stop to write when something is of concern to us. The articles that balance this tend to be those that the *Newsletter* editors think are so interesting that they are able to prevail upon their colleagues to write about something that is "merely interesting" or "just neat." Jeanne Bamberger's article on the first page of this issue is a good example of a solicited piece. But, for the most part, we write only when we want things to change; only when we think the Institute could be doing something better; only when we want to convince our colleagues that there is something wrong, something that could and should be fixed.

Therefore, this issue is **not** a "What's Right With MIT" balancing act. This issue too contains articles of concern to the MIT faculty: the need for change and the difficulty of achieving it, issues concerning what we teach and how we teach and how we find time to teach, even articles concerning the ultimate governance of the Institute.

But these individual concerns are only the surface detail. The easy answer is, as is often the case, misleading. The focus on fixing that which is not necessarily broken, but only sub-optimum, is a hallmark of MIT. We think things can be fixed if we understand them, we think about them, and take the appropriate actions. This is something that is right about MIT.

Another common theme concerns the need to change what we are doing now. The unstated fact is that this desire to change is almost entirely self-imposed. We want to change because we want to become even better than we are now. No one is forcing us to change; most people think we are pretty good as is. Yet we all know that we will change, as we have changed before. Change will be difficult, as always, because some of our existing structures, grown comfortable over the years, will disappear. It will be difficult because many of us will have to find new ways of teaching, new ways of doing research, and new ways of raising funds. We will be discussing increasingly complex issues, issues which do not fall easily into our established disciplinary boundaries; issues with wider constituencies and greater impact. All of this will be very difficult, and yet we are forcing such change upon ourselves because it will, in the long run, be beneficial to our students, to our country, and to the world. This is one of the things that is right about MIT.

There is a well-worn adage about academic infighting being so extraordinarily fierce because there is so little to fight about. That adage is not applicable here. People do worry about parking spaces, and offices sizes, and committee assignments here too. But we spend much more time looking outward. At MIT we realize the stakes are very high, because what we do affects the world. Our battles are spirited but they are not vicious. We are concerned because we want the Institute to be a good place for our students to learn. We are concerned because we want the Institute to be a good place to do research. More than anything, our concerns measure what is right with MIT.

What is right about MIT is that we use our *Faculty Newsletter* to point with alarm, to extrapolate disturbing trends, to measure reality against the ideal, to try to convince our colleagues to think differently about things. We do not try to "defeat" our colleagues, but to convert them to our view of the best way to achieve our common purpose. We do have a shared agenda. MIT is a place where high quality research and teaching take place in order to make the world better. Our goal is to instruct and inspire our students so they will share our dreams and go out into the world armed with the necessary tools. Our place at MIT makes it easier for us to do that. We recognize that covenant. MIT's reputation enhances each of our own, and we know that we have a reciprocal responsibility to preserve and enhance the reputation of the Institute. We work well together and indeed we are discovering more than ever the joys of shared intellectual pursuit. What's right with MIT is that this common purpose is so deeply rooted that we do not think it necessary to speak of it.

What's Wrong With MIT?
(Continued From Page 4)

Our concerns are all superimposed on a common vision.

What's right with MIT is that we are very good at what we do and yet we are dissatisfied. What's right with MIT is that others deem us Number 1 and yet we know we could be better. What's right with MIT is that we are willing to tackle the awful complexity of the real world, even if it forces us to change an enormously successful enterprise. MIT is resource for our country and for the world. What's wrong with MIT is that we can't quite agree on the best way to make it even better. We will probably never agree, but MIT will continue to get better.

Editorial Committee

*Those Wagnerians who believe Brahms was correct, need not write. Those letters will not be published.

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Next Issue

Next month's *MIT Faculty Newsletter* will be the final issue for the semester. As such we will attempt a year-end review and a look-ahead to the immediate and long-term future of the Institute.

We hope to address a variety of topics, including the presidential search, potential education reforms, and reports from various faculty committees.

We encourage contributions on these topics or any issue that is of interest to the MIT community.

Please forward your submissions to: *MIT Faculty Newsletter,* 38-160; or to any member of the Editorial Board.

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Errata

Due to a production error, Table III from Vera Kistiakowsky's article "Underrepresented Minority and Women Faculty at MIT" in the last issue of the *Faculty Newsletter* contained incorrect data. A corrected version of the table is printed on Page 11 of this issue. Thanks to Dean Gerry Wilson for his letter pointing out the inaccuracies.

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The source for last issue's "Top Ten Salaries at MIT" was the 1988 MIT Federal Tax Return.

Also garnered from that Return are the facts that MIT that year had a total revenue of $1,073,728,000 of which "tuition and other related income" totaled $134,539,000.

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Statement for the *Faculty Newsletter*

Dear Colleagues,

The events of early March concerning my nomination for the Presidency of MIT are receding slowly into an un-noteworthy history. As I began to disband my research group and to plan a future without active participation with my peers in research and teaching, I was unprepared for the acute sense of loss I experienced. I assure you that the difficult and awkward decision to withdraw my nomination was made on this personal basis. It would undoubtedly have been best to have made the decision earlier but that is now history. However, I would like to take this opportunity to express my regret to those colleagues who have been inconvenienced by my change of course.

This first day of spring corresponded to the completion of my teaching responsibilities, made difficult this semester by the circumstances. I now find myself looking forward once again with intense enthusiasm to the research of students and fellows in the lab and reading the articles which have accumulated in an embarrassing pile over the past months.

Since the Executive Committee of the Corporation has decided to continue the search for MIT's next President, we may be able to celebrate the selection during this season of renewal. I join you in anticipation of this event and hope to contribute as a faculty member to the continued success of MIT.

Phillip A. Sharp
Professor and Director
Center for Cancer Research

FROM THE FACULTY CHAIR

Community Events
Henry D. Jacoby

Earth Day. A number of environment-related activities are being arranged at MIT on and around Earth Day, April 22. The MIT Colloquium on April 18 will involve students and faculty in a discussion of "GREEN: A Colloquium on the Planet", and student organizations are planning booths and displays throughout the week of April 16. As one possible component of this time of special focus, a group of students has asked if there was a way to encourage individual faculty to integrate environmental concerns into

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the classroom during that period. In response, the Context Support Office is circulating a letter to faculty asking us to consider whether such material could be introduced into lectures or other educational activities.

This is an opportunity, I believe. It often is argued that the goals of Context would be best served if the social implications of science and technology were to show up more often within standard academic subjects, as well as in separate offerings focused on one issue or another. Here is an

opportunity to try introducing such material when student interest is high. Even small departures - a class, or an example or two within a class - might provide useful and interesting connections for the students: e.g., the way a particular differential equation shows up in environmental models, the chemistry or biology of some environmental phenomenon, the politics of an environmental issue. I understand that the timing and topic have to be right for this to be a comfortable thing to do, but I would encourage everyone who is teaching this spring to look for those fortunate coincidences where it might work.

Faculty Dinner. By now you should have received a letter from Tom Allen and me on behalf of the committee that is arranging a faculty dinner to honor Paul and Priscilla Gray. After discussion with the Grays, the committee has decided to move the dinner to the fall, when we all hope to be able to celebrate Paul's move to the Chair of the Corporation, rather than toast the Gray family's patience and stick-to-itiveness (for which they surely deserve credit as well).

When you clear your calendar of the previously planned dinner on April 27, please make a note of the new date which is Friday, October 19. Please note also that the biennial MIT-wide ball, which has in the past been hosted by the Grays but is being given in their honor this year, is going on as planned on Saturday night, April 28.

Memorials and Celebrations. We lost two valued colleagues in the past few months: Dick Adler and Doc Edgerton. In each case there was a community gathering to mark their passing. Both events were wonderful. The graciousness and care that went into these services, and the wide

participation, were of course measures of the two people. Both were important contributors to their academic fields, and both gave lifelong service as teachers and mentors. Both were admired and beloved for their human qualities. But I also felt something else going on in these gatherings, broader than the

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recognition of two individuals. Something about MIT itself. The Institute seems to understand and value these symbolic events that draw together the community as a whole. Not just a particular department or school, but the wide spectrum of faculty, staff, and students. Sitting in these services, I was proud to be associated with an institution that not only attracts and sustains people like these two, but that is able in a public way to celebrate them. And to celebrate itself as it does so. That they brought forth this type of community expression was their final gift to the rest of us.

Ambivalence of Service: Noblesse Oblige or Stigma?
Catherine V. Chvany

As a refugee in the 1940s, what I found most striking about America was not its material culture, its cowboys, or even Hollywood, but its unique tradition of philanthropy and volunteerism. Nowhere else in the world were towns and schools and libraries governed by volunteers, colleges and scholarships founded by individuals, musical organizations supported by the performers. Generosity in democratic America was not the privilege of a few Medici; it was open to a much larger aristocracy.

When I joined MIT in 1967, several members of this community were already known to me through their community service: Jerry Wiesner had served on Watertown's Planning Board, and then on its School Committee. Student volunteers - no less busy than today's - taught Saturday classes for high school students. Junior faculty had shining examples to follow: if Philip Morrison made time to attend an Electives Midway, if other luminaries served as Freshman Advisors, how could a junior claim to be too busy? Noblesse oblige meant time was given to service, not because it was worthless, but because one felt rich enough to afford it.

Since then, professionalization has eliminated much of the need for volunteer labor, and that's Good News. The Bad News is a devaluation of voluntary efforts that are still needed. When money won't stretch but volunteers are scarce, service becomes required. Involuntary service equals second class citizenship, even in democratic America, at democratic MIT. While a sense of noblesse oblige adds to psychic income (as in S. J. Keyser's piece in the last *Newsletter*), stigmatized service subtracts from it.

What has happened to change service from noblesse oblige to a dirty word? What was once done cheerfully enough for intangible rewards has become damaging.   Juniors are counseled to remove service items from their CVs - a record of service to community "would be laughed out of School Council."   And if service "doesn't count" for juniors, what about service by seniors?   It is a strange

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paradox that "service department" and "service teaching" have become terms of opprobrium; if the teaching of subjects that are required, i.e., most needed, is stigmatized, then who'll want to do it? Are those of us who still enjoy undergraduate teaching automatically suspect? Even as Humanities sections develop small graduate programs, their major responsibility will still be to the undergraduate program. Within the diverse disciplines MIT defines negatively as Humanities - the fields other than science or technology, which have no graduate programs - an important source of unity is the faculty's shared concern for excellence in undergraduate education.   As a source of psychic income, the pleasure of teaching MIT's bright students compensates for other handicaps.

Instead of deploring "service teaching," MIT might well marvel at the service aristocracy it has developed in Humanities. For at least ten years, MIT's Humanities has been unique among undergraduate programs nationwide. Even in the very best undergraduate liberal arts colleges, only a tiny minority of faculty engage in activities typical of graduate faculty - participating in international panels, in personnel and program reviews for graduate programs, refereeing for major journals, serving on national and international boards. But at MIT, such activities are as typical for faculty in Humanities as they are for their peers in graduate departments at MIT and elsewhere. Time and again, on panels and boards composed of members of the strongest graduate departments, the MIT Humanist is the only colleague teaching in a purely undergraduate program. To have achieved this level, not only in the absence of graduate teaching, but with only the skimpiest undergraduate programs, is quite miraculous.   MIT Humanists have reason to be proud, and MIT has reason to be proud of its Humanists, and of itself for providing an environment where this could have happened.

Since MIT's finances will not permit making up in real income for all the country's economic ills of inflation, taxation, and salary compression, MIT will continue to need service and teaching at a level it cannot adequately compensate in money. For Jay Keyser, MIT's reputation provides a major component of psychic income; in Humanities fields, the prestige exchange is less mutual. Along with efforts to increase real income, special care is required to maintain and enhance the level of psychic income, particularly in Humanities, where MIT's reputation is based on individual research supported by 9-month salaries at the lower end of the spectrum.

For many, one of MIT's main attractions is that it is a community of overachievers. But a situation where external "thank yous" or "well dones" grossly outweigh internal ones becomes a centrifuge. The *Newsletter* has been concerned with big things like harassment, but absence of harassment is not enough; nor is it enough to celebrate Nobel prizes.   A healthy institution requires that teaching and service be a source of psychic income rather than a tax on it. That requires a campaign of affirmative courtesy.

Time for a New Education Professional at MIT?
Daniel S. Kemp

Yet another task force to refocus the curriculum of our undergraduate science core? However much I admire the dedication of those who again take up this thankless task, the prospect summons in me a twinge of nausea, recalling my many impotent hours spent in such deliberations. Unbidden, the image of a latter-day Rip van Winkle springs to mind: appointed as a hapless junior faculty member to an MIT core committee, fallen asleep at the first meeting, only to wake 50 years later, a member of a successor committee where an identical discussion is in process.

Hyperbole? Consider the following quotations, taken from each of the major educational reviews conducted at MIT during the past 40 years:

"(A major aim of the core curriculum is) To improve the subjects of instruction by reduction of detailed content and by increased emphasis upon fundamental principles and upon the development of powers of judgement and discrimination in the formulation and application of those principles."

Report of the Lewis Commission 1949

"The intellectual experience of the first two years is not as closely related as it should be to the ultimate activity and role of the student. The student...finds it a kind of battle....The rewards...should be better related to the excitement and intellectual satisfaction we would like (the student) to have."

CCCP Report 1964

"A majority of MIT's students...reject the less structured aspects of their science courses in favor of the obvious tools and techniques."

Report of the Hoffman Commission 1970

"Students are exposed to principles, but do not get a vision of the scientific method. Students are short-changed by the style of how the basic subjects are taught. They see a succession of well-defined exercises, but do not receive an education."

Professor A.P. French/CUP Winter Work Session/1988

Given the attention and effort this problem has received in the years since the Lewis report, its evident intractability bears a strong message. The remedies cannot lie in the kinds of curricular and structural chances that we have tried thus far. We have been looking in the wrong places. Either radically new tactics are needed, or there are no remedies.

I have taught in the science core at MIT for many of the past 25 years. For all its rewards and gratifications,

Is It Time For A New MIT Commission?
Fred Moavenzadeh

The Lewis Commission was created in 1947 in recognition of societal changes brought about by the termination of World War II. These included the emergence of the United States as the major economic and military power in the world; the tremendous technological development of the World War period that could be put to commercial use; and the recognition that a new engineering education may be needed in order to take advantage of the technological developments for enhancing human welfare and to expand and accelerate the scientific and technological momentum of the period.

The Commission, by making several bold and innovative recommendations, laid the intellectual foundation for an educational transformation. In a short period of time the Institute was transformed from its parochial Boston Tech image into a renowned world-class institution of science and technology. Soon MIT was in a class of its own.

In the late sixties, when alienation, discouragement, and frustration with an unjust United States involvement in Vietnam was tearing our social fabric apart and had raised serious questions about the mission, relevance, and utility of our technological preoccupation, MIT established a second commission, entitled "Creative Renewal in Time of Crisis." While making several interesting and worthwhile recommendations, the commission served primarily as a

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mechanism to diffuse the tension that had been growing at the Institute. It provided a forum for debate and discussion, a mechanism to allow for an orderly and, occasionally, a heated venting of frustrations by alienated community members. Its presence softened the impending violence, and saved MIT from the substantial disruption that had occurred in other academic institutions.

At the present time, changes both in the United States and the world at large warrant a reexamination of MIT's role: the Cold War appears to have ended; the United States is no longer the dominant economic power in the world; at least two other economic powers of equal, if not greater, importance have emerged (Japan and the European Economic Community); the decline in our

II. About Change: Tactics

Margaret MacVicar

When talking about education, it is prudent to be brief. For if there is nothing in what one says, the reader will appreciate the author's concern to promote the absorbing of nothing with economy of effort. If one is profound, on the other hand, the perceptive reader will recognize germinating truth and transplant it to his/her own experience.

I assume you have read last month's nonexhaustive list of difficulties often encountered by would-be innovators. The right question to ask about what to do next depends on the state of development of the innovation, and also on every constituency with which it came in contact. Some tactics that might be useful to help innovations occur, survive, and prosper are listed next. Some of them are obvious. Others are exactly counter to conventional wisdom on the subject - a fact that especially recommends them, since conventional wisdom has proven barren for so long. They come instead from the real life experience of those who are educational prime-movers on the local, national, or international scenes. Do not be put off by apparent flippancy in some of the statements. This comes from the realities of the cold cruel world but it does not affect inherent truth.

Tactics for Change

A. *Wheel in a Trojan Mouse:* Sometimes you have to change everything in order to change anything. But more often, you can install a small "experiment" that you know will work, and use it as a point of student and faculty infection. The Trojan mouse is not a passive example to be ignored but a rallying point and base of operations for a bunch of greek commandos. A small initial project is easier to staff than a big one, cannot fail loudly, attracts those students with whom it is most likely to succeed, allows entrenched alternatives to die quietly as students vote with their feet, and develops a shadow cabinet of expertise that can install a successful program on a larger scale with minimum fuss later.

B. *Seduce Co-conspirators:* Success of an innovation requires the hard work of first-rate people. Never ask for a commitment, particularly in advance. Invite a person to consult with others on the design and installation of the innovation. Commitment will automatically follow contribution to the program.

C. *Suppress Surprise:* Never cease checking, checking, checking with all whose acquiescence is necessary to the future growth of an innovation. Bring them up to date while asking advice on the latest developments. When some other person complains about you, his/her superior or colleague must feel on the inside, in the know, and must not be surprised.

D. *Don't Ask Permission:* If a permission-giver is good, include him/her in the project or on the committee that plans or supervises it. Otherwise appear before all committees and officials as information-purveyor and advice-seeker only. Remember that it is easier to ask for forgiveness than for permission. When permission is absolutely necessary, there are usually alternative sources for that permission: choose your friends.

E. *Manufacture a Mneat Mnemonic:* Academics like Everyman, live by labels. As the commercial world knows, finding the best name is often the single most difficult creative part of introducing a new product. A good label is absolutely essential if funds are to be raised.

F. *Take the Education Purpose Seriously:* Always a disturbing tactic, but sure to elicit change if pursued vigorously. Opponents are mystified by earnest, passionate dedication.

G. *Establish a Win-Win Game:* It is often possible for every participant in a game to gain by mutual accommodation. Even when resources are scarce and the size of the total pie appears fixed, close examination may reveal that some slices represent nonconsumables that may be shared by two or many participants. When you organize the game, look carefully at what each player perceives (or should perceive) to be a winning score and see that nobody loses.

H. *Pry With the Power of a Pittance:* The threshold for change is sometimes surprisingly low. A little money for a student desk in a laboratory, for an easy chair in the lounge, or for some Xerox of student papers shows your good faith and can get the innovation moving quickly. No matter that everyone recognizes a later expansion will require departmental funds: the chairman is so relieved to have one person enter his office who does not want money Right Now that s/he will let tomorrow's worries take care of themselves.

I. *Universal Virtue Corollary:* Since you never know who your friends are until the crunch, elicit help by presuming cooperativeness and good heart on the part of everyone.

J. *Be Specific But Don't Get Caught in the Briars:* People will accept in practice a proposal they would reject in principle. Often by suggesting procedures one can say more and be less threatening than by discussing generalities. On the other hand, label all written statements DRAFT, even the final version. In this way each examiner can feel s/he influences details and little time is lost wrangling about the wording.

"Demonstrating Under the Dome" and the Rashomon Effect

Louise Dunlap

There are at least three versions of what happened in the lobby of the Sloan School on March 2. National network news showed a rainbow of MIT students demonstrating for divestment. The theme (as a colleague in Pittsburgh later told me) was the students' dedication to an issue many had thought resolved with Nelson Mandela's release from prison. Leaders of the anti-apartheid organizations recently unbanned in South Africa, however, have called on the international community not to abandon - in fact to strengthen - the economic sanctions that have brought the movement this far. And MIT students were among the first to respond to the call.

A second version of the story - carried by the *Boston Globe* and other local media - is probably better known to MIT faculty. This version emphasized the problematic behavior of students who were at it from 7 a.m. on and who were so persistent in their attempts to reach the Faculty Club to speak with members of the MIT corporation that police reinforcements needed to be called in to clear one of the Sloan elevators. Police were the losers in this version. Five officers were injured and one (as I write this) is still not back to work, according to campus police chief Ann Glavin.

The version of the story that I experienced has received little media coverage and may not even be known to most members of the faculty. What I saw as a participant on March 2 was a creative group of demonstrators, responding with song and other time-honored techniques of non-violent protest, to a very rigorous challenge from campus and Metropolitan District police. Most challenging in my view was what appeared to be selective treatment by the police of students of color. As I said in a March 6 letter to

The Tech, five out of the six demonstrators who seemed to be roughly treated were students of color - and this in a crowd where caucasians outnumbered them about three to one.

Since this third viewpoint has received so little attention, I want to say just a bit more. Student participants in the demonstration thanked me for my letter, saying it expressed what they too had observed

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but hadn't said, because they didn't think they would be believed. Those who were standing in better view of the elevator than I (including my RA from fall term) said they found it hard to understand how officers were hurt there and hard to believe police had needed to send for reinforcements just when things were quieting down (as they perceived it). They reiterated their belief that they had been peaceful and were surprised at the treatment they received.

I don't think anyone really knows how to establish which of these stories - and the many possible combinations and individual variants of them - has the most validity. As Chief Glavin puts it, "Demonstrations have a life of their own. Often five or ten feet away, you see something entirely different." I wholeheartedly agree and wish that I and all of us in the Sloan lobby could have "seen" more.

I have been organizing workshops on race and ethnicity for

several years now, and I have learned that assumptions about color are very deeply hidden, even from ourselves. Part of "seeing" is learning to acknowledge. Without these workshops, I'm not certain I would have been conscious of what I saw. I was glad to learn from Chief Glavin that the campus police are involved in ongoing training on the issue. The students may also be planning some form of training in non-violent civil disobedience, such as they have seen in *Eyes on the Prize*.

Is there a way for all of us to see (and act) more clearly in the heat of events? Would there have been as much discrepancy among stories if, for instance, television cameras and the only other faculty observer (Faculty Chair Henry Jacoby, who was actually shown on the national news speaking with students) had reached the Sloan elevators 15 or 20 minutes sooner during the crucial episodes on March 2?

One point on which everyone seems to agree is that we need more faculty observers at every demonstration. Maybe, like me, your conscience compels you to "demonstrate under the dome" (Paul Samuelson's effective phrase in the February *Faculty Newsletter*) or maybe you want to see action taken on the faculty's 3 to 1 vote for divestment five years ago. Maybe you are more interested in accurate observation or in ways of bridging the painful gaps of the Rashomon effect. In any case, it seems to me that student protests and the response of the campus police raise issues that directly concern those of us who want to teach in an institution where justice and clarity prevail. Whatever our concerns, we will do well to follow events, watch for posters announcing demonstrations, and be there with our notebooks.

Is It Time For A New MIT Commission?

industrial competitiveness and productivity is cause for concern; our technological prowess seems to be challenged; awareness of environmental and global change is no longer a simple academic exercise; explosion in information technology and potential threats to our fundamental freedoms have raised serious ethical questions; the consequences of technological advancements seem frequently to add more to our social debits rather than to our social benefits; hazardous waste, polluted waters, fouled air, congested roadways seem to cry for a better

> Our recent well-publicized and well-received initiative in productivity and competitiveness seems limited in its impact....The difficulty is that MIT's intellectual fabric views such efforts as transplants, and their antibodies automatically and subconsciously attempt to isolate and limit their infringement on what is regarded as the central mission of MIT.

integration of technology in our social systems; our multi-ethnic society seems to call for a new social order. Internally, within MIT, our admission policy, family-work policy, our reliance on the government for research support all compete for our attention.

These issues cannot be ignored, nor can they be dealt with in isolation from each other. Over the past decade we have attempted to cope with these issues on an *ad hoc* and piecemeal basis, as if they were all isolated and unconnected events.

Over the past two decades, for

example, we have made serious commitments to develop a viable academic program in the broad area of Science, Technology, Society, and Policy. This program unfortunately has neither developed the necessary intellectual critical mass, nor has it attracted a sufficiently large number of undergraduate or graduate students. Similarly our concern with the environment and global changes has succeeded largely only when the concerns could have been mapped into the intellectual domain of a disciplinary department. Interdisciplinary effort, which many believe is as important as disciplinary research, if not more so, is still not receiving the attention it deserves; issues are being debated in an *ad hoc* fashion. Our recent well-publicized and well-received initiative in productivity and competitiveness seems limited in its impact. The lack of success may have nothing to do with appropriateness of the topic, the dedication of those that are involved, or lack of financial support. The difficulty is that MIT's intellectual fabric views such efforts as transplants, and their antibodies automatically and subconsciously attempt to isolate and limit their infringement on what is regarded as the central mission of MIT. In order for these efforts to succeed, they must become an organic part of the Institute and of MIT's culture. They cannot simply be added to the system - as transplants or as well-intentioned but alien efforts. Their mission seems to be inconsistent with the current intellectual framework that still draws its legitimacy from the Lewis Commission of the late 1940s.

To allow these and other important endeavors to flourish and grow at MIT, we must provide a new, fertile intellectual soil, where the intellectual seeds for analysis of these important and socially relevant issues can germinate as successfully as have

the science-based disciplines, such as computer science, biological science, and genetic engineering. All of these sciences have flourished within the intellectual framework of the Lewis Commission. They have not challenged its premises: These sciences are as relevant now as they were in the 1940s. But the world has changed; to some extent so has MIT; and our commitment to our society requires us to acknowledge the changes and respond accordingly.

Soon MIT will have a new administration. We need to discuss - initially perhaps through the *Faculty Newsletter* - the desirability of a new MIT Commission which could develop a new intellectual fabric, the basic platform for propelling the Institute into the next millennium. We need to discuss its mandate, its format, and its mission. We need to deliberate its structure and the appointment of its members - whether it be a presidential committee or a faculty committee appointed by the chair of the faculty, and so on.

It is imperative to reexamine and reevaluate MIT's role in a rapidly changing world. A new MIT Commission may be an appropriate mechanism for so doing. In any case, we cannot afford to ignore these issues nor their implication for our mission and our education strategies.

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> The more complex a thing is the more its present features depend upon the retention of unique configurations that resulted from the resolution of some historic conflicts during growth.
>
> Cyril Stanley Smith

Conspiracy or Caprice?
The Fate of Interdisciplinary Subjects
Louis Kampf

What's in a decimal point? At MIT, when it comes to educational policy, apparently a great deal. If you look at the Humanities section of the MIT Bulletin 1989-90, you will find a small group of courses under the rubric of "Interdisciplinary Subjects." Their numerical designation is "21.9..." It seems that the ".9.." designation is bothersome to the office of the Dean of Humanities and Social Sciences.

I am puzzled about this. So is everyone else I've talked to. After all, the category seems quite innocuous. When Dick Douglas became Chair of Humanities during the 1960s, he instituted the interdisciplinary decimal. No one felt disturbed; indeed, there was a good deal of excitement about the development of interdisciplinary courses. A substantial number of courses were initiated, and became quite popular amongst undergraduates. The advantage of the "21.9.." designation was that one did not have to clear courses through the departments and sections representing the standard disciplines. Courses were cleared through the Chair of Humanities.

Thus people wanting to offer courses did not have to deal with the special interests of individual disciplines. The intellectual space opened by the "Interdisciplinary" designation allowed the development of the first women's studies courses at MIT, courses in the social sciences challenging the standard paradigms, courses about Greek antiquity, etc. These courses had to justify themselves on intellectual and educational grounds, rather than the demands of a particular discipline.

Only a few of these courses are still being offered. Next year there will be none. I found out about this mop-up operation when my department administrator informed me that the numbers under which I and Noam Chomsky had been offering several very popular courses were now relegated to the waste basket. I called up the dean's office, and was informed that the "21.9.." designation could not be maintained for Chomsky and me. When I asked about the fate of the courses, I was told to find a home for them in some other departments or programs. Recall that the very reason for the rubric's existence is precisely the avoidance of formal approval by departments.

Now this involved a fairly substantial curricular decision. It was carried out by fiat. As far as I know, no one outside the dean's office was consulted. Certainly I wasn't. Furthermore, the only reason given for the cut was bureaucratic: that "21.9.." is somehow inimical to the bureaucratic sense of order. I was given no intellectual reasons, nor any financial ones, since the designation didn't cost any money.

It's ironic that this petty closing in of educational space should occur at a time when MIT is making public claims about the opening-up of its curricular and intellectual purpose. Wiping out the "21.9.." designation not only eliminates what's already in place, but it shuts off one venue for the development of future interdisciplinary courses. Flexibility again falls victim to bureaucratic whimsy.

A nastier interpretation of events is possible. Both Chomsky and I are fairly well-known for our radical political perspectives. Is the bureaucratic impulse to eliminate a number being used to dissolve politically bothersome courses into thin air? I hope not. But I do have my suspicions.

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TABLE III*
Number of Women Faculty In Each School and
The Department of Psychology/Brain & Cognitive Sciences

School	10/75	3/80	6/89
Architecture & Planning	11	8	11
Engineering	7	15	17
Humanities & Social Sciences**	18	29	26
Management	2	3	11
Science	15	15	18
Psychology/Brain & Cog. Sci.	3	3	5

*This table is reprinted with corrections from Page 22 of the last issue of the *Faculty Newsletter (II,4)*.
**Not including the Department of Psychology

Time for a New Education Professional at MIT?
(Continued From Page 7)

I have been deeply troubled by the experience. Given the potential abilities of our students, the educational process of our core curriculum is woefully inefficient for most, and for some, it deals a brutal blow to self-esteem that is motivationally counterproductive.

Only teachers who have found genuine educational panaceas can speak authoritatively on these matters, and thus far despite much effort, I have not. However, by the slow process of classroom experimentation I have been

> ...a need exists for comprehensive, focused research into the particular problems of teaching and learning that arise in the MIT core curriculum.

able to exclude as irrelevant most of the simple and obvious remedies. There are strong hints of deeper problems and solutions. Let me mention only two.

1. The quality of the learning experience is sensitive to the educational structure in which it occurs. Experiments with alternative styles and formats for education are needed.

Consider the following example. Many students at MIT experience barriers to learning attributable to cognitive clashes between their learning expectations and the learning styles enforced by the instructor. Because it maximizes isolation of the lecturer from the class, the usual format of a large lecture subject thwarts detection of cognitive learning problems. However, relatively simple, cost-effective structural changes in that format can give the lecturer essential feedback.

2. The learning that results from our core subjects is often distinct from the topics that appear in the syllabus. In evaluating a subject, we

have to examine the teaching and learning experiences at both the transmitting and the receiving ends.

Creative development of new lecture outlines and subject sequences by itself is not enough to challenge the intractable problems of the core curriculum. If the minds of students are not effectively engaged, a faultless presentation of a subject can be highly flawed teaching. Evaluating an educational feast by examining only the menu and the remarks in the guest book is superficial and out of touch with the dimensions of the problem. We must ask not merely, "What was presented?" but, "What was consumed?", What was digested?", "What was assimilated?", and a year later, "What was retained?". The instructor in a subject lacks the time, the resources, and the authority to address these questions in their necessary depth.

In 1986 the progress report to the faculty by the Commission on Engineering Undergraduate Education spoke of the need for an organized effort to communicate the skills of teaching. Amen. But more than this, a need exists for comprehensive, focused research into the particular problems of teaching and learning that arise in the MIT core curriculum. We could use a team of professionals who are prepared to work with lecturers and instructors to assess and refine the quality of our existing offerings and to help in the construction of new experiments that can truly define education here in the 21st century.

Not every aspect of the educational scene must be described as deja vu. Learning psychology has made significant strides since the time of the Lewis report, and some of this work has been done here at MIT. It is time we took a professional look at the boundaries and practicalities of education in the core curriculum.

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On Increasing Collegiality
Peggy Richardson Enders

In the years I've been at MIT, I've met a fair number of faculty from all over the Institute. I've known many of you as teachers and seminar leaders, as UROP and thesis supervisors, as freshman and upperclass advisors, as members of an unending number of faculty committees. And I've sat with you during some of those endless meetings.

I've noticed something I want to share: too often, many faculty in the room don't know each other. Too often, these are faculty members who have been at MIT for a long time and who have a lot in common.

One wonders whether MIT might not be a happier place for faculty and students if it were easier for people to find out about each other, meet each other, have a chance to talk to each other. Does the meeting have to be the predominant place to get together a roomful of people from different departments?

A recurring topic among faculty who wish they had more chances to meet is the absence of an appealing, centrally located faculty common room. Appealing has often been described as quiet, with newspapers and pots of hot coffee and tea and fresh pastries; the central location has often been suggested as the dome of Building 10 (under the dome, that is) or perhaps a room in Walker. No styrofoam cups in sight.

I've also heard more than once that it would be a lot easier to mix it up on campus if a shuttle were provided to get someone from Building NW12 to Building E53 in less than the 20 minutes it now takes. And wouldn't it be nice, others say, if that shuttle made it possible for one to quickly end the ride if you spot someone you want to talk to. In response to these shuttle suggestions, the Context Support Office will sponsor a design competition for ideas of different types of "MIT People Movers." Watch for details.

Divestment Would Still Be a Relevant Action for MIT

Willard R. Johnson

This article appeals to the faculty to renew its call to the MIT Corporation to divest this institution of its remaining equity investments in companies doing business with or within South Africa. This is the least we can do at this crucial turning point in South African history, when, with a little greater external pressure, the recalcitrant forces in power there can possibly be pushed to accept the conditions necessary for a real democracy. Without such, there is no hope for peace and a renewal of prosperity, but there is a possibility for great tragedy.

No doubt, almost everyone in our community knows enough about the horrors that the apartheid system has caused to feel the affront it poses to one's sense of human decency. Also, we are all probably aware that the most important leaders of the South African democratic forces have been calling for not only continued but even increased external pressures on the South African regime.

Not only has Nelson Mandela called for increased sanctions, but during a visit to Cambridge and Boston in mid-March, to me and others, so too has the Afrikaner churchman, the Rev. Beyers Naude. They have reaffirmed what South African newspapers have written and South African government officials have privately stated to some American contacts, that the sanctions have been quite effective. Their total economic impact, combining the loss of export earnings, withdrawn capital, absence of normal capital inflows, and the multiplying impact these funds would have had in recirculating through the economy, approaches one hundred billion rand (which even at today's highly depressed rand-to-dollar rate still amounts to tens of billions of dollars).

It is untenable to continue to argue that divestment can make no effective contribution to the achievement of these kinds of external pressures. The campus divestment movement, with 155 colleges having divested over $5b, is already a demonstrated success. Since I called for such action at MIT in 1971 and tiny Hampshire College actually got the ball rolling, we in the divestment movement have so sensitized our society to the realities of the apartheid system and the dramatic sacrifices for democracy being made by the masses of the people there, that we have seen a change in the country's general moral stance right before our eyes; so much so that 83 cities, 25 states and 19 counties have now taken some form of divestment or selective purchase action. Over half of American companies have now disinvested, pulling out over $12 billion. The U.S. Congress so felt the political weight of these actions that they voted the first override of a veto by President Reagan to pass the comprehensive anti-Apartheid bill of 1986.

MIT has yet to fulfill its moral and practical role in this campaign. Some believe that we are actually investing more money now in businesses with a South Africa connection. As of 1986 we recorded only $153M in such businesses, a figure which seems to have risen to about $289M by last year.

MIT is still regarded as one of America's preeminent sources of intelligent influence on modern society. An action now to rid ourselves of the moral fetters that continue to link us to apartheid would not go unnoticed and would add important popular pressure on the U.S. Congress and the Administration not to lift or lighten the sanctions on South Africa, as reactionary forces are now actively pressing them to do, but perhaps even to increase them. Of course, if we have an opportunity to do so, we should also speak our individual and collective voice directly to the Congress on this issue, as other college communities have done, and perhaps also limit our purchases from companies with South African links. But, let our action be clear, visible and quick.

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> An action now to rid ourselves of the moral fetters that continue to link us to apartheid would not go unnoticed and would add important popular pressure on the U.S. Congress and the Administration not to lift or lighten the sanctions on South Africa, as reactionary forces are now actively pressing them to do, but perhaps even to increase them.

> The week after the historic unbanning of anti-apartheid organizations in South Africa, Patrick Lekota, Political Secretary of the largest of the organizations (The United Democratic Front) visited Boston and spoke at MIT about the continued need for economic sanctions. For those who missed Lekota's speech, a video is available through The Special Program on Urban and Regional Studies, X3-5915.

II. About Change: Tactics
(Continued From Page 8)

K. *Recast the Recollection:* "Do you remember that suggestion you made two years ago?", you say to department head or administrator. "Well, I didn't understand it then; now I do. Here is what you meant, and you were right...," followed by a description of your innovation.

L. *Be a Wolf in Sheepskin:* Identify an already-established program, title, department, bureau, committee, council, or standing procedure with which the innovation can clothe itself. The exhausting procedure of approval is already completed for the covering activity, requiring further enabling concurrence of only a few key people. Your assumption of the label will, of course, be a fulfillment of its meaning of which the originators who saw it only vaguely can now claim proud authorship.

M. *Remain an Eternal Experiment:* Most faculties are open to temporary experiments, limited in scope and duration. Obtain approval for an experimental program and renew its license regularly as it becomes an organic part of the academic program.

N. *Move the Middle:* In missionary work the preferred first convert is the chief. But the thoughtful middle is indispensable for acceptance and especially for spread and survival of an innovation. Data and conclusions from the experience of others using similar programs elsewhere may actually be useful. Did you know for example, that there is a national professional association for the 4-1-4 IAP academic calendar schedule?

O. *Establish Categories of Evaluation Yourself:* The alleged virtues of any proposed program carry an implicit statement of the grounds on which the innovation will be evaluated. By making the evaluation categories explicit you can make clear what you

propose and also preempt the high ground from which its program will be surveyed.

P. *Keep House:* The registrar is often driven bonkers by the mismatch between loosely stated conditions of a new program and the rules within which s/he is constrained. Whether one is a villain or a savior may depend on an hour spent to resolve these at the right time. Similar attention to the room schedules office and the buildings and grounds department may help.

> **U.** **Cherish Diversity:** No one thing is good for all students or for a given student all of the time. Failure to recognize this is the rock on which more innovations have foundered than any other.

Q. *Urge Students to go to the Top:* "Is the next course going to be taught this way too?" Ask the Department Head. "Why can't all four years be organized the way this year is?" Ask the School Dean that question. "Does teaching matter?" Ask the Provost. "Is anyone listening?" Put headlines in the campus newspaper and find out.

R. *Survive Like the Species (or Cluster The Clusters):* Disseminate like mad in your own locality and leap-frog to distant germination points where colleagues do the same. If three people follow your example - and supply their own driving power as inventors, not copyists - and if three people follow each of them, then the growth rate is exponential. Only in this way can a new species survive against competition.

S. *Spread By Subcultures:* Student contacts extend their grass-roots

between institutions far and wide. Presidents, deans, and professors spread more informal information at cocktail parties than anywhere else.

T. *Invoke the Majesty of the Name:* Make judicious use of the sonorous title "Massachusetts Institute of Technology" to hop over thresholds elsewhere. Even though this may cause resentment, the name can be used by local advocates on their colleagues, often for a net gain. All sorts of names carry conviction: "The Department Head wants...." and "The Corporation has committed itself...."and "The Foundation has funded....." are all symbolic statements of great convincement.

U. *Cherish Diversity:* No one thing is good for all students or for a given student all of the time. Failure to recognize this is the rock on which more innovations have foundered than any other. Conventional education (lectures, problem sets, hour exams, and all that) is exactly right for some students at some stage of their development. Total conversion, like prolonged total immersion, can be suffocating for innovation and innovatee alike.

V. *Let the User Add the Eggs:* Cake mixes that require only water to be added do not sell so well as those to which the customer adds the eggs. Best of all is for the customer to be in on inventing the innovation. Second best is to have clear in your own mind which features of an innovation are central to its success and to encourage personalized modifications of all other qualities.

W. *Play the Conference Game:* There are at least a thousand kinds and lengths of conferences, and the conference game is well worth learning to play. A first rate conference

II. About Change: Tactics
(Continued From Page 14)

flatters the attenders, gets their undivided attention by removing distractions, enables first class leadership to be assembled on a short-term basis, permits considerable influence, and gives legitimacy to any project back on the participant's home campus. Conferences are often easier to fund from outside sources than the programs they are designed to disseminate.

X. *Raise the Budget, Cut the Budget, Or Go Bankrupt:* Antioch College originated the work-study program for its students when it nearly went broke. Radical cuts may be necessary for radical inventions, which often result in doing something else (once in a while something better) for less. Build incentives by making sure that savings are put at the disposal of those doing more for less, not used to wash out the carelessness of others.

Y. *If All Else Fails, Resign:* As a human sacrifice, one may succeed in catalyzing the changes hitherto stalled.

My two checklists, (I.) Difficulties of Change, and (II.) Tactics for Effecting Change, derive from a commitment to working within the framework of an institution to accomplish changes. None of the suggested tactics are designed to destroy or circumvent due process, although some do encourage a reinterpretation of which due process owns our allegiance. The goal is to skew the system toward greater humanity, quality, effectiveness, and style. Amen.

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> Men may be convinced, but they cannot be pleased, against their will.
>
> Dr. Johnson

A Proposal to Extend the Examination Period to 5 Days
(Continued From Page 1)

grade one (or more) conflict examinations. Both difficulties have become more serious in the last decade as the number of exams given has nearly doubled. Both difficulties would be partially alleviated by extending the exam period each term to 5 days.

Our proposal is easiest to understand in the form displayed in the table on Page 16. In the fall term, the only change proposed is to shift one day from the Reading Period to the Exam Period. Actually, since no **examinations** are added - only examination **days** - this change does not really involve any "sacrifice;" in effect, one Reading Period day which

> Our proposal is easiest to understand in the form displayed in the table on Page 16.

currently **precedes** the Exam Period is simply shuffled statistically into the **middle** of the Exam Period. The spring term proposal is more complex because of constraints imposed by Commencement, weekends, and holidays. In essence, the suggestion is to add 1 day to the Reading Period and 2 days to the Exam Period by starting the term 2 days earlier (during the traditional 2-day vacation period at the end of IAP) and by reducing the President's Day vacation weekend from 4 days to 3. Again, it can be argued that holidays have not really been "taken away," but merely shifted to the Reading and Exam Periods where we believe their impact will be more appreciated by many students and faculty. Even students and faculty without finals may find the proposed schedule attractive since for them the spring term ends several days earlier than at present (with no reduction in the number of scheduled days during the term).

Obviously, any change in the calendar will work a hardship on some who have designed their activities around the current arrangement; the hardships of which we are aware seem to us less severe than those we are trying to alleviate. Obviously, too, changing the calendar is an emotion-laden activity; each individual has his or her own values and ideas and priorities. In designing our proposal, we have been guided by one major principle. We have tried to limit our changes to just those necessary to achieve the narrow goal of reducing the density of examinations during the Exam Periods. Our proposal is thus an *ad hoc* quick fix for a specific problem we perceive as serious. We do not view our proposal as in any sense a complete **permanent** solution to all the complexities and troubles that many associate with our current calendar. The duration of our proposed changes is consequently limited to a fixed period of 3 years, starting next Fall. Hopefully, within that period there will be an opportunity for a more comprehensive review of calendar issues, which we would certainly like to encourage.

Our proposal has been extensively discussed with various faculty and student groups. Such discussions seem inevitably to wander off in many directions - the relationship of the calendar to "pace and pressure," the role of IAP, the value of finals in HASS-D subjects, etc., etc. We have tried to avoid taking a position on or prejudging any of these issues. We are only interested in the narrow question of whether our proposal is better than the current arrangements. We believe it is. We believe the majority of those we have talked to prefer the new proposal. We would like your support. We would also like to hear from you if you have questions, comments, or suggestions. Please call me (3-3716) or any member of the *ad hoc* committee.

PROPOSED CALENDAR CHANGES

	Current Calendar	**Proposed Calendar**
End of Fall Term (1990-93)		
Thurs	Classes	Classes
Fri	Reading Period	Reading Period
Sat	Reading Period	Reading Period
Sun	Reading Period	Reading Period
Mon	**Reading Period**	**Exams**
Tues	Exams	Exams
Wed	Exams	Exams
Thurs	Exams	Exams
Fri	Exams	Exams
Beginning of Spring Term		
Wed	IAP ends	IAP ends
Thurs	**Vacation**	**Spring Term Reg Day**
Fri	**Vacation**	**Classes***
Sat-Sun		
Mon	**Spring Term Reg Day**	**Classes***
......		
Mon	Pres. Day Vacation	Vacation
Tues	**Vacation**	**Classes***

*Marks 3 class days which are picked up in proposed calendar.

|		
End of Spring Term		
Fri	Classes	Classes
Sat-Sun		
Mon	**Classes**	**Classes (Tues. schedule)**
Tues	**Classes**	**Reading Period**
Wed	**Classes**	**Reading Period**
Thurs	**Classes**	**Exams**
Fri	**Reading Period**	**Exams**
Sat	Reading Period	Reading Period
Sun	Reading Period	Reading Period
Mon	Exams	Exams
Tues	Exams	Exams
Wed	Exams	Exams
Thurs		
Fri	Final grades deadline	Final grades deadline

The following week (the one before Commencement) remains the same as at present.

M.I.T. NUMBERS

ACADEMIC SCHOOL BUDGETS BY SOURCE
(FY 1988) ($000)

	Budgeted General	Funds	Sponsored Research (Actual)	TOTAL
Architecture	8,492	3,932	6,189	18,613
Engineering	37,893	19,903	74,365	132,161
Science	27,228	6,647	97,405	131,280
Humanities	16,001	3,385	2,014	21,400
Sloan	16,026	1,284	2,850	20,160
TOTAL	105,640	35,151	182,823	323,614

ACADEMIC SCHOOL BUDGETS ($000)
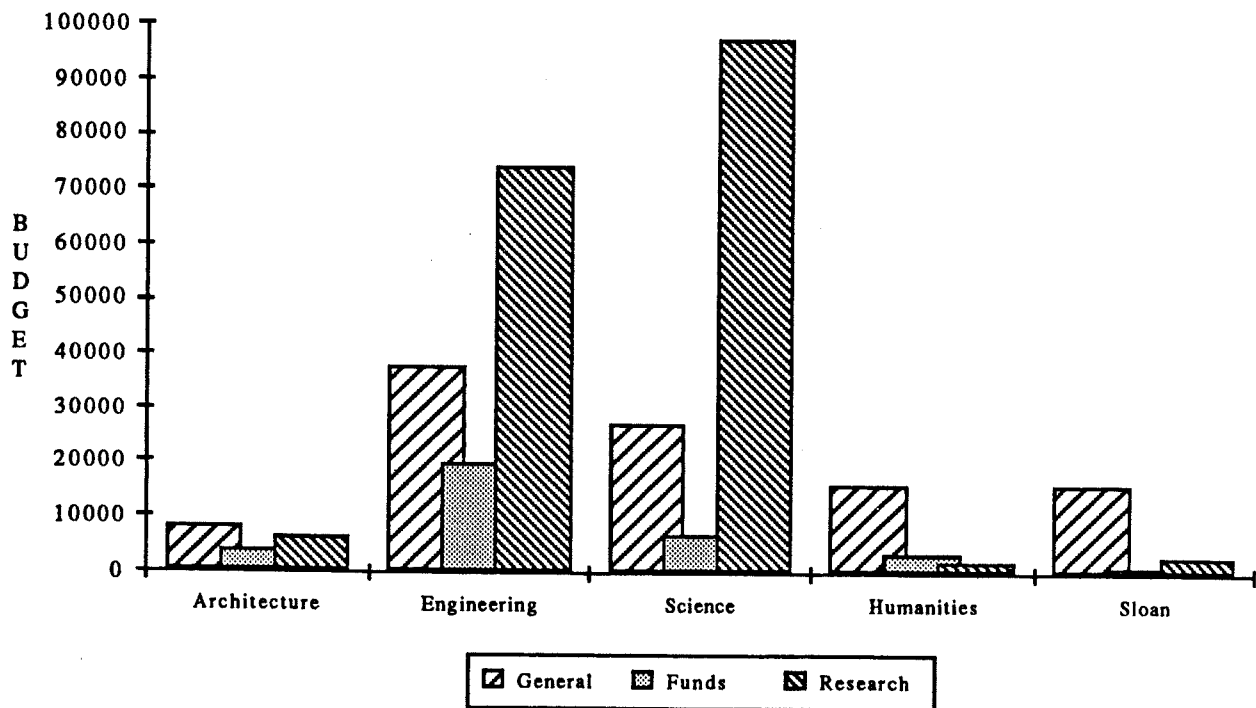
Source: MIT Factbook/MIT Planning Office

A Laboratory for Developing Musical Thinking, Hearing and Appreciation
(Continued From Page 1)

details of compositions that otherwise seem to elude them - a movement from a Bach Suite for unaccompanied cello, a Mozart minuet, or a Schoenberg song. And principles of coherent design (what works and what doesn't) with which our students were already familiar in other domains could gain new and more palpable meaning as they took shape in this less familiar medium: symmetry, balance, repetition, variation, transformation. Moreover, questions that show up in probing the nature of other materials would show up here, too: what generates boundaries, what is a relevant entity, how to segment and what to attend to among the multiple possible dimensions of phenomena unfolding in time? In short, I saw a way of bringing students into the serious art and discipline of music while at the same time using, enriching, and perhaps even perturbing the skills, ideas, and know-how that our students already had.

But there were at least two constituents and a warning that had to be kept in mind: First, the students needed to immerse themselves in significant pieces of music. Listening closely to and learning how to make "appropriate hearings" of these pieces as they evolve in great detail, should be the basis for setting problems and also the goal of the students' work. And second, the problems students worked on in the Lab should be **real musical problems** - problems that grew out of and also elucidated hearing the underlying structures and relations of the works they were studying. But, the potential technology had to be easy to use and most of all it had to be kept from driving the enterprise - a means, not a flashy end in itself.

With these ideas in mind, and with the help of a revolving cadre of UROP students along with support from Project Athena, I developed a computer music language and an expandable sample of projects which came to be known as MusicLogo. Like its relative LISP, Logo is an extensible language and one that is especially apt for developing musical structures because it is hierarchical (small procedures can be nested in larger procedures) - a feature that characterizes the organization within

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and among the multiple dimensions of musical structure. By incorporating MIDI compatible music primitives into the Logo language, students have all the procedural power of Logo and in addition, the capability to work with at least four separately programmable musical strands ("voices") and a wide selection of "instruments." Thus students can immediately hear their procedural descriptions "performed" by the synthesizer. We also implemented a range of interesting music graphics, each of which highlights different aspects of the same musical configuration. As a result, students can test the relations between their procedural descriptions, graphic representations, and what they actually apprehend - each one informing and enriching the other.

In the fall of 1987, the Lab, which includes 10 IBM AT computers and several Macs, each interfaced with a Casio synthesizer, was up and running. To prepare for the students enrolling in Basic Musicianship, and in my course, Developing Musical Structures, I wrote a general Sourcebook and also a book of composition-like projects. These projects guide students through experiments that cover a wide range of musical materials and do so in a way that helps them probe and develop their healthy musical intuitions. Thus, instead of asking students simply to "identify" intervals, scales, or chords, the projects give students "design constraints" within which they can actually build and become functionally fluent in using these basic relations. For instance, students are developing a working sense of rhythmic structure by designing computer percussion pieces that generate contrasting meters; making percussion accompaniments that "fit" or conflict with a given melody; transforming the grouping-structure of a melodic motive by keeping its pitches the same but changing its durations.

But the most powerful aspect of this computer environment, one that I hadn't anticipated, turns out to be its capacity to generate confrontations between descriptions and perceptions. This becomes evident in the surprises that occur as procedural descriptions became sounding structures. In wandering through the Lab, I hear our students meeting these surprises in what I think of as typical MIT fashion: "Wow! I wonder why that happened?" These are the moments of most intimate learning. They are also the moments when "units of description" (which too often loop around referring only to themselves) and "units of perception" (which are often left unnoticed and unarticulated) are brought into direct confrontation with one another. For given the specificity

A Laboratory for Developing Musical Thinking, Hearing and Appreciation
(Continued From Page 18)

of computer descriptions and the immediacy of sounding results, students can ask, when confronted with a surprise, "What did I expect this description to sound like and what was the basis for this expectation? How would I now describe what I have just heard, and what are the differences?" For instance, a motive whose description the computer and the synthesizer repeat exactly the same way on each iteration, may be perceived as quite different when embedded in the context of itself or in a new context.

What you say is what you get, but only with respect to how and what you have available for constructing its meaning. With the immediate possibility to move between media and between description and perception, I see students developing the capacity for multiple ways of representing phenomena to themselves; and they are also developing the ability to select among these various kinds and sensory modes of representation depending on where and for what they want to use them. Indeed, learning that there are multiple representations of phenomena, and that one can selectively choose among them, may be the most important kind of learning that is going on here.

In ways that I had hardly anticipated, the computer environment is serving as a means through which students can probe, reflectively question, and become intimate not only with their own musical intuitions but with assumptions in other domains as well. And this result reveals the hidden part of my agenda: Working in the Lab, students are drawn into examining assumptions they have come to take for granted. These include what they know, how they have learned it, and even assumptions about the meaning and referents for common symbolic expressions: numerals, simple

proportional relations, and ordinary arithmetic functions when referring to and actually generating musical materials take on new, unexpected meanings. For instance, one student used factors of 12 (6, 4, 3) as values for beats in several voices "performed" by several different percussion instruments. Expecting that the simple arithmetic relations would produce a simple, coherent rhythm, as well, he heard instead, a surprisingly complex and conflicting rhythm. And in probing for how to account for what he heard,

> In ways that I had hardly anticipated, the computer environment is serving as a means through which students can probe, reflectively question, and become intimate not only with their own musical intuitions, but with assumptions in other domains as well.

fundamental aspects of rhythmic structure were opened up for scrutiny. He found himself asking: what generates a beat, what takes precedence given multiple levels of periodicities, what accounts for perceived accents and for perceptual conflict? Returning, then, to works we were studying in class, his experiment led us to ask: How do composers use relations like these to create tension or stability, as means for development, variety, and transformation, while still remaining within the constraints of perceptual coherence? And most of all, students were able to focus their attention on, hear, and appreciate aspects of works that had been inaccessible to them before.

At the same time, students' musical intuitions are becoming

available for scrutiny, too. For example, after close listening to and analysis of a given composition (e.g., a movement by Vivaldi), each student develops his or her own set of computer procedures that describe Vivaldi's characteristic compositional procedures - what the students call "Vivaldi's intuitive tool kit." And since these procedures actually play, students can, on listening back, test their analyses of the work. The project brings each student into very intimate contact with Vivaldi, but it also leads to another surprise - the discovery that their procedural analyses inevitably fail in a very critical way. The aspects of a work that distinguish a composer like Vivaldi from his lesser contemporaries are just those unique moments (very often the "joints" between one section and another) that **cannot be reduced to procedural generalization.** And this discovery in turn gives pause to notions of what the computer is and is not good for: Rather than a medium that can substitute for and/or make thinking, listening and playing music on real musical instruments easier, the computer becomes a medium through which to interrogate and challenge one's everyday knowledge so as to build on it. In this way the Lab serves not as a source of answers, but rather as an environment for moving towards a better understanding of how learning happens.

But learning only happens when you are learning about **something.** In this environment, students are learning how to understand and to hear the detailed "workings" of musical structures. And with that they are helping me to resolve the set of gnawing issues that generated all this in the first place: I see them being moved by the artistry of composers whose works may previously have simply passed them by.

MIT's Nobel Prize Laureates

David Baltimore, Medicine and Physiology, 1975 (Faculty);
Eric Chivian (Physicians for Social Responsibility), Peace, 1985 (Medical Staff);
Richard P. Feynman, Physics, 1965 (Alumnus);
Murray Gell-Mann, Physics, 1969 (Alumnus);
Har Gobind Khorana, Medicine and Physiology, 1968 (Faculty);
Lawrence Klein, Economics, 1980 (Faculty);
Salvador E. Luria, Medicine and Physiology, 1969 (Faculty);
Robert S. Muliken, Chemistry, 1966 (Alumnus);
Franco Modigliani, Economics, 1985 (Faculty);
Paul A. Samuelson, Economics, 1970 (Faculty);
John R. Schrieffer, Physics, 1972 (Alumnus);
Samuel C. C. Ting, Physics, 1976 (Faculty);
Susumu Tonegawa, Medicine and Physiology, 1987 (Faculty);
Charles H. Townes, Physics, 1964 (Former Provost);
William Shockley, Physics, 1956 (Alumnus);
Robert Burns Woodward, Chemistry, 1965 (Alumnus).