

The MIT Faculty Newsletter

Vol. V No. 4

March 1993

Some Reflections on the New EECS M.Eng. Curriculum

Leon B. Groisser

I might have made some remarks if it had seemed appropriate at the December faculty meeting at which the new Master of Engineering (M.Eng.) proposal came up for a vote. Since there was no discussion on the proposal then, I think it might be useful to give some of my personal reflections on the new program.

One Comment

The EECS Department, as the advocate of the entire proposal, carried the burden of the presentation to the Institute and properly focused on its own curriculum. This meant that practically no time was devoted to the larger issue which enables every MIT engineering department to adopt an M.Eng. degree program.

Three Opinions

First, MIT's adoption of the five-year professional M.Eng. program should cause such programs to spread throughout engineering schools, thus raising the level of professional engineering education nationwide. Second, as I understand the program, the EECS B.S./M.Eng. program is indeed

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Universities and the Technology Enterprise: A Personal Experience in Japan

Jesus A. del Alamo

This article was adapted from my testimony to the President's Council of Advisors on Science and Technology (PCAST) given at MIT last year. PCAST came to MIT to gather information about research-intensive universities and their relationships with the federal government.

My testimony was based on my over two-year working experience in a Japanese industrial research laboratory, prior to my joining the MIT faculty in 1988. I learned to speak relatively fluent Japanese and I was able to observe personally both the strengths and weaknesses of the Japanese system compared with our own.

Several years before that, as an undergraduate student in telecommunications engineering in Madrid (Spain, my native country), I got engaged in the development of silicon solar cells in one of the labs of the school during the heyday of photovoltaics. The contagious excitement of this early research experience brought me to Stanford University to pursue a Ph.D.

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Editorial

Faculty Malaise: A Case of Learned Helplessness?

We are living in a very singular moment of history. It is a moment of crisis, in the literal sense of that word. In every branch of our spiritual and material civilization we seem to have arrived at a critical turning point. This spirit shows itself not only in the actual state of public affairs but also in the general attitude towards fundamental values in personal and social life.

Max Planck, 1933.

Several articles in the present issue of the *Faculty Newsletter*, as well as a number of articles and editorials in previous issues, prompt us to speak of a critical situation, in the sense nicely epitomized by the Chinese pictograph which composes "crisis" (wei chi) out of elements borrowed from the pictographs for "danger" (wei hsien) and "opportunity" (chi hui).

In our last issue, Provost Wrighton addressed at considerable length and in substantial detail the present state of MIT finances. "The financial problems that face us are not of crisis dimensions,"

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Editorial

Faculty Malaise: A Case of Learned Helplessness?

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he said in concluding his remarks. "Rather, we face a situation that needs to be addressed over a period of time, in order to strengthen the Institute both in terms of finances and the excellence of its educational and research programs."

Provost Wrighton spoke about the prospect of budget cuts and their prospective impact on research and teaching, and cited "evidence that committed effort is rewarded" and attributed the Institute's continuous advancement of excellence to "strong student, faculty and staff resolve to sustain MIT's leadership role [as well as to] prudent deployment of financial resources. We cannot afford to support all faculty or student initiatives. The task before us is one of setting priorities and executing our mission with available revenue. As a community, we must understand and address the financial circumstances that represent the boundary conditions of the problems that need to be solved."

And yet, as of this moment of writing, the *Newsletter* has received no communications from members of the faculty regarding the provost's remarks on the MIT financial situation.

How come?

Could it be that this total absence of response is due to the faculty's complete and unqualified confidence in the steps that the administration has been and is taking in this connection? We do not believe so. On the contrary, our experience convinces us that most of our colleagues take a quite different and less rosy view.

Fiscal issues are a part of our predicament. They must be confronted responsibly, and as Provost Wrighton rightly says, "...we must understand and address financial circumstances that represent the boundary conditions of the problems that need to be solved."

But let us also ask: Who is the "we" that the MIT administration has in mind?

In the penultimate section of his essay on MIT finances, the provost mentions "briefing" various Institute groups and names many senior administrators and various "cross-functional" administrative units and subgroups that he and President Vest have formed to "provide guidance in closing a \$20 million operating gap (including a \$10 million budget deficit) over a three- to five-year period...[by focusing] on improvements and efficiency enhancement, as well as areas for possible reduction, reorganization, or elimination."

With a single exception, this part of the provost's account is notably devoid of reference to any plans the administration may have for enlisting faculty members more broadly in the "guidance" process. Indeed, the only faculty member mentioned by name in this connection is the chair of an *ad hoc* faculty/administration committee appointed by the provost to advise him on issues related to indirect costs and graduate student tuition. By the same token, this *ad hoc* committee is the only conjoint faculty/administration group whose involvement in the "process of planning and review" is noted.

The exclusion of the faculty from meaningful and effective involvement in the development of MIT fiscal policy is nothing new. And that is one reason why we feel that there can be no more erroneous way of thinking about our present predicament, than to identify it solely as financial in nature.

Just as there is more to the environmental crisis than the material reality of increasingly unbreathable airs, undrinkable waters, and uninhabitable places, so too the present state of affairs at MIT has both tangible and intangible aspects. To be more precise, in defining and dealing with the situation facing us, we must pay as much attention to relatively broad and long-term questions

about the kind of community that we are and would aspire to be as we do to relatively narrow and short-term problems of reconciling costs and revenues.

Let us not be misunderstood. We are not here to lay blame on others for the relative unresponsiveness of the faculty to MIT's present financial problems. As Professor Frankel points out elsewhere in this issue of the *Newsletter* (p. 9), the fiscal situation is not the only one that presents causes for concern. Time and time again, we see ourselves and our MIT colleagues failing to react constructively and proactively to conditions under which we – as members of any other community worthy of the name – would quite readily evince a sincere sense of shared concern and come together as responsible individuals to engage in socially responsible action.

How are we to explain this unresponsiveness? It is possible that in addition to our shared mental and behavioral inclinations toward scientific and technological pursuits, we all also share peculiarities that render us individually and collectively incapable of taking an active stance when necessary.

Arguments that attribute prevailing patterns of behavior to such "dispositional" determinants have seductive appeal. However, we find it more plausible to conclude that the instances of unresponsiveness at issue here are more reasonably explained in terms of "situational" influences. It is our contention that presently-prevailing patterns of faculty unresponsiveness on issues relating to intra-institutional affairs represent a case of what experimental social psychologists have come to call "learned helplessness," and that this state of affairs derives from the historically long-standing nature of faculty/

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Faculty Malaise

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administration relations at MIT.

Like many broadly significant scientific discoveries, the phenomenon of learned helplessness was encountered accidentally by researchers who were looking for something else. The essential finding is simple and straightforward. Organisms (including people) exposed to aversive or noxious stimulation (e.g. painful electric shocks; unpleasantly loud noises; etc.) initially respond as might be expected: with energetic efforts to terminate, to escape from and/or to avoid the stimulation. If and when the situation is such that this initial responsiveness proves unavailing, active behavior gives way to profound passivity. More to the point: If, after being treated in this way, the subjects are exposed to the same or similar stimulation under conditions where ample opportunities for terminating, escaping from, and/or avoiding the stimulation are provided, their previously acquired patterns of unresponsiveness tend to persist.

When painful experience teaches us that it is beyond our power to bring about changes in prevailing conditions, we learn to stop trying. In humans, events other than exposure to inescapable sensory stimulation at aversive intensities are sufficient to induce learned helplessness. Indeed, people generally tend to develop mental and behavioral patterns of unresponsiveness in any problematical situation where prior experience has

(relatively) consistently confirmed the expectation that present behavior and future outcome are not related. To be more specific: Once learned, the expectation that responsiveness to aversive conditions in a given environment generally proves futile, tends to inhibit present and future responsiveness in that situation by undermining both (1) the motivation to respond and (2) the cognitive capacity to perceive the existence of opportunities to respond effectively if and when they become available.

But that is not all. When we find ourselves in situations where our responsiveness is ineffective in producing initially intended effects, we tend to ask ourselves an important question: What is the cause of my present sense of helplessness? Needless to say, the answer we give turns out to be crucial in determining where and when expectations of future failures will recur.

This is not the place to rehearse the full range of possible explanations. For most of us, the patterns of unresponsiveness at issue here are probably quite context-specific; there presumably are very few (if any) members of the MIT faculty whose feelings of helplessness are so global and stable as to be attributable to internal (characterological or constitutional) factors. On the contrary, in our academic and professional lives outside MIT, most of us presumably are pretty much unaccustomed to the experience of feeling

academically and professionally ineffective, incapable, and helpless.

If we have learned to be responsive and proactive in other realms of our professional and academic lives, why not also at MIT?

However one answers this question, it should be noted that what has already been said about learned helplessness applies likewise to learned competence; both are engendered by experience and both rest upon contextually-specific learned expectations concerning the relationship between present behavior and future outcomes.

Change is always difficult and painful. But change is needed. And it might as well begin with us. Do we have what it takes to relieve our institutional malaise? Are we ready, willing, and able to join with the MIT administration in the process of shaping the future of this unique place? Are they ready, willing, and able to accept us as full partners in this task? And what is the Corporation's view of these issues?

Editorial Committee

The *Faculty Newsletter* Board is considering instituting an electronic bulletin board to facilitate more casual discussion of issues of interest to the faculty. Comments are welcome at fnl@zeiss.mit.edu.

MIT Cost Reduction Strategies and Faculty Input

Provost Wrighton has asked the Institute faculty and administration to work with him to reduce costs, increase efficiency, and identify new revenue sources compatible with our research and teaching missions. His appeal is in some respects similar to President Clinton's call for economic sacrifice from the wealthy and middle classes: the federal government will rein in expenditures in exchange for substantial increases in taxes

and fees.

We, the faculty, are the "wealthy and middle classes" and the MIT administration is the "federal government" in this analogy. The analogy is loose because the faculty, in contrast to our national body politic, can be both positive and proactive participants in the process by which we achieve these objectives.

Perhaps the first step in this process is the asking of relevant questions. For

example, what cuts, if any, are planned in the Institute's administrative budget? Or, how do our costs compare with those of comparable universities? And perhaps most basically, is enough detailed information available to the faculty to allow for an educated judgement?

As a first step, let's expand this list of questions and then gather facts that may answer them. If we do this, we are on our way to responsible debate about tactics for quality management of the Institute.

Editorial Committee

The Edgerton Center

J. Kim Vandiver

Last September, Provost Mark Wrighton and Prof. Paul Penfield, head of the Department of Electrical Engineering and Computer Science, announced the opening of the Edgerton Center, located at Edgerton's Strobe Alley. The general purpose of the Center is to provide the kinds of hands-on experiences that incoming students often lack today that come from real-world design and construction projects and experimentation.

Educational Goals

Concrete experiences help students appreciate the abstractions they encounter in the classroom and for many these experiences fulfill a preferred style of learning. These alternatives are needed because for many students the first year or two at MIT become a time of survival rather than a time of excitement and discovery. I am afraid that this condition will only worsen when the biology requirement kicks in – not due to anything inherently problematic with biology, but because of the addition of another demanding, lecture-recitation-problem set style of subject in the first year.

Another goal of the Center is to help undergraduate students find mentors. Ed Land called them "ushers" when he gave the address that inspired what we now know as UROP. I believe mentors are an essential ingredient in encouraging students, especially women and minorities, to pursue advanced degrees. All of our Center activities are intended to encourage the formation of mentoring relationships.

Our staff is small (two part-time faculty, two part-time instructors, a technician, and a secretary), so that in order to achieve our goal of having significant influence on undergraduate education, we will need broad community participation.

Activities This Year

This year has been one of experimentation, in an attempt to discover new ways to reach students with the resources they want and need.

Fall Term

We offered two Freshman Advisor Seminars with a hands-on, learning-by-doing emphasis. We also continued the popular "Strobe Project Lab" subject made famous by "Doc." In one of the seminars Prof. John G. King, the principal architect of the 8.01X and 8.02X physics subjects, led a band of freshmen in designing a new Corridor Lab experiment, which went on trial in the Hayden Library during IAP. Concealed counters have revealed that the apparatus has sustained thousands of trial operations by passersby. Hundreds of them have taken the time to record their data on a pad provided for the purpose. There is still time – go try it out.

Independent Activities Period

The Edgerton Center offered a number of activities ranging from racing MITEE Mouse robots to making high-speed video images. Perhaps our most significant single achievement during IAP was providing resources for 50 students to pursue projects in machine shops. This required the collaboration of the Edgerton Center, the OME, and three machinist/technical instructors from different shops. A spin-off of this was the development of a continuing mechanism for providing machine shop resources to students with a need who seek us out. For example, we have made arrangements for the Solar Electric Car Club students to have access to supervised machine shop resources on a regular basis.

Coordinating resources scattered around the campus (such as shops) is one of the principal ways that I, as

director of the Edgerton Center, can make a significant contribution to making more resources available to students.

Spring Term

We again have the Strobe Project Lab course, and two undergraduate seminars. One of the seminars is being led by Dr. Charles Mazel of Ocean Engineering. It is entitled "You've Got a Good Idea, Can You Make It Work?" and is intended for students who have their own ideas for projects, but need a place to work, materials, and sometimes simply encouragement. Our role is to facilitate, to help them define their goals and then to find the resources they need. In addition to providing funding for some materials, we try to introduce them to experts on campus who can give them advice and guidance.

Six students are now enrolled, working on the following self-motivated projects: 1) A collision avoidance sensor for small aircraft; 2) Neural Nets; 3) Musical Virtual Reality; 4) Digital sound sources for greeting cards; 5) A low-cost sensor for estimating the ultraviolet hazard on a given day; and 6) A new kind of snow shovel.

There is a significant unmet demand for UROP experiences among freshmen. The Mazel subject is a type of pre-UROP experience. As we help these students to connect with faculty who are working in related areas, we are creating potential UROP relationships at the same time. We are attempting to satisfy these students' desires to work on real things and to develop mentoring relationships at the same time.

Summer

The Institute needs to make better use of its educational resources in the summer term. The Edgerton Center is currently making plans to provide resources for a

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The Edgerton Center

(Vandiver, from preceding page)

hands-on physics laboratory experience for Interphase students. As resources and community energy and enthusiasm (that means you) permit, we should be able to make a contribution to the MIT efforts in primary and secondary education, as well.

The Edgerton Center Needs You

As director, one of my tasks is to discover and try out new ideas. If you want to try out a new seminar or project that is consistent with the Center's mission, I would like to hear about it. I

around the campus. We have four projects pending with faculty who wish to try out the system in their experiments. Do you have a project and a student you would like to involve?

Hands-on Seminars

MIT's fall term Freshman Advisor Seminars have been a great success, with essentially every student who wants one being matched to an advisor (900 students fall term). If you would like to offer a hands-on seminar next fall or spring that requires shop, material, or

on a Saturday morning expedition to find an airplane, which had been ditched at sea last summer by an MIT professor. The job could have been accomplished by a team of three, but the boat had room for six. The students were accommodated at no cost and had a terrific experience conducting a sonar survey. The mission was a success, as you may have noticed in a *Tech Talk* story last fall.

I would like to see such adventures offered on a much broader scale. Many students and faculty do not have the time to commit to a long term UROP, but the student's need for sharing in the excitement of realistic professional experiences is still important. Much benefit to students could come from going with you on a consulting job, from sharing with you a significant moment in an exciting experiment, or attending with you a professional symposium. It was suggested to me recently that we might establish an electronic bulletin board for making such connections on a very short notice basis.

What Next?

All of the initiatives described above have the characteristics of providing opportunities for students to engage very early in the doing of engineering and science. The experiences also provide many opportunities for students to form mentoring relationships with faculty and staff. Stimulating experiences and rewarding relationships are strong medicine for the sufferers of IHTFP.

The creation of the Edgerton Center is not only a chance to provide rewarding experiences for students but is also an opportunity for collective faculty action to bring about change in the way we deliver undergraduate education. Please get in touch. I would like to have your ideas for appropriate goals, as well as your participation in carrying them out.

Part of Doc Edgerton's magic with students was the occasional short notice adventure that he would lead, taking the first three students to come in the door for a morning outing on the Charles River or Boston Harbor, as he tested out the latest piece of gear. This last fall we had the occasion to do the same.

have three suggestions which will require significant faculty participation. Each is described briefly below.

A Different Brand of UROP

I have received \$7000 from sponsors to support student projects and I believe that it will be possible to raise much more. Harvey Mudd College has been doing it for over 25 years, funding UROP-like experiences for undergraduates with projects solicited from industry. Such an endeavor needs faculty advisors to work well. One possible reward for faculty would be ILP revenue sharing points. Please let me know if you would be willing to serve as an advisor or have suggestions for companies or individuals that might be interested in sponsoring projects.

The first company to participate in this is Kodak. To stimulate interest they have loaned the Edgerton Center a \$100,000 high-speed video motion analysis system. They have also given us a grant to fund UROP students to use the system in research applications

experimental resources that you don't normally have access to, we should talk. The deadline for getting into the published booklet for fall term seminars is April 15th.

The greater need is for fun, hands-on seminars in the spring. I would like to see a new form of mini-subject evolve which students could use to satisfy the Institute Laboratory Requirement. The requirement might be satisfied by taking 3 or 4 of these mini-subjects. With your participation, I would like the Center to be able to offer a wide spectrum of hands-on subjects, in both the spring and fall terms.

Adventures of Opportunity

Part of Doc Edgerton's magic with students was the occasional short notice adventure that he would lead, taking the first three students to come in the door for a morning outing on the Charles River or Boston Harbor, as he tested out the latest piece of gear. This last fall we had the occasion to do the same. Dr. Charles Mazel took three students along



In Memoriam – Bernie Feld**Philip Morrison**

Bernie Feld, professor of physics, MIT (emeritus) died on February 19, after a few weeks of acute illness in the city of Brooklyn, near where he was born. His entire career is remarkably entwined both in symbol and in substance with this half-century's fateful choice between catastrophic war and uncertain peace.

With an undergraduate degree in physics from the City College of New York, he had all the talent and ambition (but none of the money) to enter graduate study at Columbia. The versatile, citywise student came once he could earn his way by assisting a brand-new physics professor. The new man was Enrico Fermi himself, fresh from Rome via the Nobel award at Stockholm; the new year was 1939, world war in the offing; the new challenge was the fission of uranium, recognized worldwide in mid-January to imply an inordinate release of energy.

To no physicist was the hint more vivid than to Leo Szilard and to Fermi, old friends in Europe, now partners and to a degree rivals there, around Columbia. Graduate student Feld went step-by-step along the long path to the bomb. In the first years he was one of very few to share the key experiments on fission. When in 1942 the mushrooming project came under Army direction, he moved with Fermi and Szilard to Chicago, where he was one among the forty-odd who helped build and watched succeed the first of all neutron chain reactions. He worked there and at Oak Ridge, and as the war neared its end, he went on to Los Alamos and to help wire the test bomb itself, the night when the desert sun rose twice.

He came to MIT after a Ph.D. back at Columbia. He was a molecular-beam theorist, then a nuclear one, then a particle theorist, always staying close to the experimenters at the MIT Laboratory for Nuclear Science until retirement. He consulted

(Continued on next page)**Bernard T. Feld (1919-1993)****Herman Feshbach
and
Victor Weisskopf**

We were friends of Bernie Feld. We were his friends for half a century, from the forties until now. We knew him as a first-class physicist and teacher, but most importantly as an active symbol of the scientists' sense of responsibility for the impact of science and technology on humanity. His achievements in this regard were monumental. He was at times editor of the *Bulletin of the Atomic Scientists*, president of the Council for a Liveable World, president of the Albert Einstein Peace Foundation, secretary general of the international "Pugwash" Conferences on Science and World Affairs. At MIT he was co-director of the Program on Science and Technology for International Security.

He was the author of dozens of articles as well as

two books on the dangers of nuclear war, on the urgent need for nuclear disarmament, and on governmental policies, national and international, regarding these issues. More generally he promoted international cooperation on behalf of improving the human condition worldwide. We all must admire and be grateful for his prodigious efforts on our behalf. As important, he was a wonderful example, especially to our students, of the concerns a scientist should have beyond those of the laboratory and classroom. He was an example of how a scientist may successfully enter the public arena and contribute to its amelioration.

Apart from his public activities, Bernie was an active research scientist in experimental and theoretical nuclear magnetic resonance, nuclear and particle physics. As a graduate student at Columbia he was asked by

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In Memoriam – Bernie Feld

(Morrison, from preceding page)

on reactors during the fifties; his admired text on early models of the elementary particles (1969) and his editing of the collected scientific papers of Szilard (1972) remain clear and direct, as was everything he did.

But that is only the academic shadow of his deep concerns. What quiet, steady Feld shared with quicksilver Szilard, for decades his friend and mentor, was an enduring responsibility for reducing the nuclear threat. His informed work and his wry opinions, both blunt and sharp, are everywhere in that worldwide effort. The organizations he worked for (and often led) began in postwar Washington with – before – the Federation of Atomic Scientists. He was at one time or another president of the veteran lobbying Council for a Liveable World, founded by Szilard in the late fifties; he took part in almost every one of the international Pugwash Conferences on many a continent. For a few years he was on leave as Pugwash executive head in London. The reference shelves hold many conference volumes he edited on the technical and political issues of the decades. His signature and work appear on a myriad of documents. For some years in the eighties he was editor of the *Bulletin of the Atomic Scientists*. The list is long; the lifelong statement is crystalline.

There were bad years too, some of the trouble a sign of failing health. A personal chronicle he published in 1979 was bleakly entitled: “a voice crying in the wilderness.” But it is satisfying to report that in many conversations over the years since glasnost, he welcomed as surprising but genuine the many signs that fearful catastrophe had receded.

His two grown daughters and a grandson survive him, with his artist-wife of more recent years. There is one sort of memorial Bernie Feld would welcome: the determination of all of us to ensure that the rosy glow where once nuclear darkness ruled is not another false dawn like the one at Trinity long ago.



(Feshbach and Weisskopf, from preceding page)

E. Fermi to assist him in his work on the self sustaining chain reaction in Chicago. That was his first claim to fame. After this he went to Oak Ridge and then to Los Alamos to participate in the development of the atomic bomb. At the end of World War II he completed his Ph.D. with a thesis under Willis Lamb which was published in 1945. This gave the theory of magnetic resonance spectra to be expected when one of the nuclei of a heteronuclear diatomic molecule possessed an electric quadrupole moment. This is a classic paper repeatedly referred to even to this day. In 1946 he joined MIT. He was promoted to assistant professor in 1948, to associate professor in 1952, and to full professor in 1955. He contributed much to the activities of the department at MIT and also at Harvard where he was instrumental in the construction of the Cambridge Electron Accelerator. He was director of the Laboratory for Nuclear Science for five years.

Bernie had a long list of papers on nuclear magnetic resonances and on nuclear and particle physics and published a definitive review article “Neutron Physics” in 1954 and a book, *Models of Elementary Particles* in 1969. In particular his work on neutron and pion scattering by atomic nuclei received special recognition. He was a founding editor of the *Annals of Physics*.

He was an inspiring teacher and was known to present complicated theoretical ideas in simple terms. Many physicists who received their training at MIT remember gratefully the instruction and the enthusiasm that he could transfer to his students.

He suffered several attacks of cancer in the last decade of his life. It was a great loss for the Department that he could no longer instill his lore and inspiration to his colleagues and students.

We miss him. ✦

Newsletter Seeks Members

It's time to consider volunteering to serve on the *Faculty Newsletter* Editorial Board for next year.

The *Newsletter* Board is composed of faculty members from a wide variety of disciplines (see list of current members on page 2) and is open to all Institute faculty on a voluntary basis. Board members serve on one or two

Editorial Committees per year, at which time topics are selected and material solicited for the current issue.

Although there is no financial remuneration for Board members, benefits gained through service to the faculty and the Institute community-at-large, far outweigh any lack of monetary compensation.

If you'd like to serve on next year's Editorial Board, or would like more information about the process, please contact any current member, or reach us here at the FNL offices: **Bldg. 38-160; x3-7303; FAX x3-0458; e-mail fnl@zeiss.mit.edu**.

Note: *Newsletter* contributions are also welcomed at the above address.

Another Academic Obituary

Ernst G. Frankel

He served MIT for 40 years or more. A dedicated teacher and researcher who devoted his whole professional life to the Institute. MIT was the center of his Universe. With hundreds of former students scattered all over, he was a welcome visitor, teacher, or adviser in many parts of the

now that the memorial will be able to meet even its very modest objectives. He is gone after doing so much, yet there is nothing to remind us of the past, of his contributions, and those of the many like him who have gone before.

The Institute is what it is not because of those who chair the committees and

goals may become permanent.

Much has changed in the last 40 years, but most importantly, we have lost much of the collegiality and respect for each other. Our main problem today is not one of a potential budget deficit, but a deficit in credibility as one of the world's foremost group of teachers and scholars, devoted to excellence in research and education. The intellectual challenge is still there and most of the faculty is still in place, but fewer take an active part in the affairs of the Institute, not because they do not want to contribute to it, but because avenues are often closed.

Though a college of teachers, researchers, and students should thrive on and encourage differences of opinion and non-establishment attitudes, their appears to be increasing pressure to fall in line. In fact, many faculty feel that their opinions and their advice are only sought when there is a problem, like a budget deficit, but that otherwise the "Administration" makes all decisions and needs neither help nor advice from the faculty-at-large on any but basic academic matters.

The faculty, like my deceased friend, is largely anonymous. It has become the silent workforce that generates education and research – the two principal outputs of the university from the shop floor – as nameless and usually unrecognized producers. There used to be a time when the faculty was the university; when individual faculty could pursue their intellectual interests and get full support and recognition from their peers and the Institute, which was their peers. Today it appears that stars, establishment members, and aggressive entrepreneurs are the only ones in focus. Recognition is reserved for them and is no longer a function of the intellectual, teaching, and research contribution an individual makes or made during a lifetime of service to the Institute.

Much has changed in the last 40 years, but most importantly, we have lost much of the collegiality and respect for each other. Our main problem today is not one of a potential budget deficit, but a deficit in credibility as one of the world's foremost group of teachers and scholars, devoted to excellence in research and

world.

When he retired at age 70 and became a Professor Emeritus, his family, friends, former students, and some professional associates gave a large reception at the MIT Faculty Club. Few of his MIT colleagues and even fewer of the MIT administration attended. He continued to work nearly full-time on research and writing and MIT allowed him to keep his office. Research funding from outside allowed him to support some graduate students, yet he could not get secretarial support either from the Department nor his neighboring colleagues, some of whom were also his former students. A secretary of another professor far from his office offered her help as a courtesy.

A few years after he died as a result of a prolonged illness, his colleagues, including former students, turned down a proposal to name after him the research facility he had founded and directed for over 30 years. A compromise was a plaque which stated that he was the founder of the facility.

Contributions to a living memorial fund were sparse and few donations came from MIT. There is serious doubt

form the administration, not because of the few shining lights who manage to achieve something particular or catch the limelight and manage to stay in it, not the ones who manage to be at the right place at the right time, or are particularly adept at external or internal politics. It is what it is because of the college of teachers and scholars who do not advertise themselves or get elected or selected to committees and various publicity venues, but devote themselves – heart and soul – to the basic purpose of this institution: to educate, teach, and perform scholarly research, and thereby work and contribute towards a better world. And it is by training students who want to work for society and not mainly for their own benefit, and who want to perform research which contributes to the common good, more than just the narrow reputation of the researcher and his supervisor.

We seem to have lost sight of some of our major objectives and I believe that unless we bring the main body of the faculty more into focus and more involved with the purposes of this institution, our departure from our stated

A Letter to President Vest

The following letter and accompanying figures (printed on the opposite page) were submitted to the Faculty Newsletter after the author failed to receive a response from President Vest.

January 14, 1993

Charles M. Vest, President
Massachusetts Institute of Technology
Room 3-208, 77 Massachusetts Avenue
Cambridge, MA 02139

Dear President Vest:

In your letter of January 9, praise of the "prudent management by prior administrations" is a most generous but seriously inappropriate gesture in present circumstances because it obscures and overlooks the real causes of our financial predicament. Indeed, the proposition that *were it not for the excesses of past administrations, there would be no crisis* is more consistent with facts.

The enclosed data released by the Planning Office in 1990 (upon your insistence, I am told) makes immediately

obvious that the deficit is the inevitable consequence of an unbridled and irresponsible growth of the administration over the past twenty-five years. Whether such growth is to be regarded as benign or malignant no longer seems a pertinent question since by size alone, the bureaucracy absorbs an unsustainable share of resources and thereby threatens the strength and vitality of our principal activities – research and education, the twin pillars of MIT's reputation and worldwide renown.

The time has come for a more radical surgery to restore the Institute to good health, but how can this be accomplished by task forces so constituted that the administration will in effect examine itself? The predictable recommendations of such an effort will once again focus on the faculty – always an equal partner in times of crisis and sacrifice. A call for greater faculty productivity (larger classes, less staff and perhaps a trimester school year) but no mention of bureaucratic waste, inefficiency, unnecessary functions and bloated staffs; a suggestion to reduce benefits and

compensation for the faculty, perhaps even a *patriotic* salary freeze of some sort, but no mention of any control on administrative emoluments; advice to increase overhead rates again but no recognition that the present level almost throttles the ability to fulfill grant objectives; a proposal, made of course with anguish, to increase tuition. In other words, anything and everything to avoid the real issue and to preserve more or less intact the status quo.

MIT is a great institution. Sadly it is not as great as it should, could and deserves to be because it has been ruled, hindered rather than helped, by an excessively large administrative aristocracy. The quality of greatness resides in the faculty, alumni and students for they are MIT and it is past time to recognize this fundamental fact and to act accordingly.

Sincerely yours,

Harvey P. Greenspan
Professor of Applied Mathematics

Two Athena Events Especially for Faculty

Open House at the New Macintosh Classroom/Cluster and "So What Is This Athena Thing Anyway?" – a chance for you to see and learn about MIT's academic computing environment.

Open House

Yes! Athena also means Macintosh! Come see our newest computing facility, a Mac classroom and cluster in Room 2-032. Four of your colleagues have already used this room for teaching last semester – come meet them, see what they did and discover how you can use this facility as well.

The Macintosh classroom/cluster features 16 Macintosh computers (11 color Mac IIci's and five SE/30's), a 36"

monitor for displaying the instructor's screen, and a laser printer. All of the Macintoshes can connect to MITnet, and can transfer files to and from Athena.

Staff members from Academic Computing Services will also be on hand to answer any questions you might have. Please try to drop by!

When/Where: Wednesday, March 24th, 2-4 PM, Room 2-032.

"So What Is This Athena Thing Anyway?"

The Athena Computing Environment has been in existence for close to ten years. You may have seen different versions of it over time, but do you know what it can do for you today? Over 150 courses make use of Athena as part of

their classwork every year.

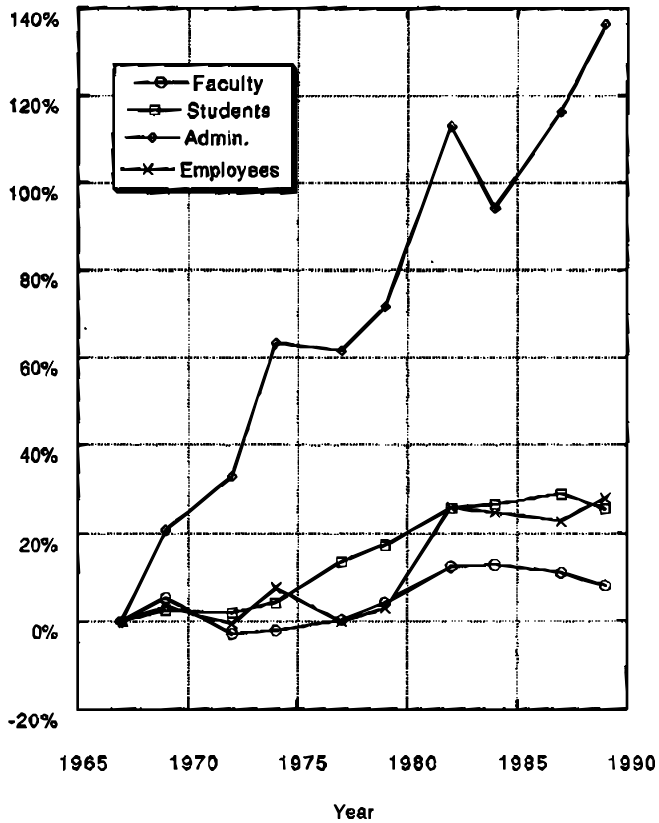
This session will show you some of the interesting things faculty are doing with Athena, and will give you ideas on how you can use Athena resources in your own teaching. The Faculty Liaison staff from Academic Computing Services will be present to answer your questions and meet with you individually as you wish.

Because seating is limited, you are encouraged to call us to reserve a spot (x3-0115).

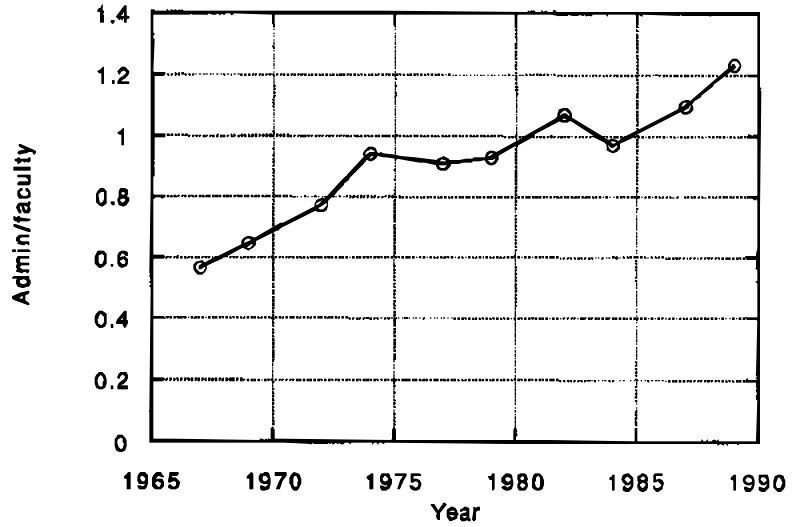
When/Where: Friday, March 26th, 10 AM - Noon, Room 1-115.

If you have questions about either of these events, please call the Faculty Liaison Office at x3-0115.

Institute Personnel % Increase Since 1965



Administrators Per Faculty Member



Total On-Campus Employees

| | <u>FY1969*</u> | <u>FY1974*</u> | <u>FY1979*</u> | <u>FY1984</u> | <u>FY1989</u> |
|----------------|----------------|----------------|----------------|---------------|---------------|
| Faculty | 962 | 894 | 952 | 1,031 | 988 |
| Other Academic | 1,070 | 1,465 | 1,389 | 1,694 | 1,837 |
| Research | 814 | 869 | 799 | 1,019 | 1,011 |
| Medical | | | | 150 | 152 |
| Administrative | 622 | 841 | 884 | 1,000 | 1,217 |
| Support | 1,612 | 1,490 | 1,322 | 1,628 | 1,691 |
| Service | <u>1,323</u> | <u>1,100</u> | <u>1,029</u> | <u>1,193</u> | <u>1,019</u> |
| Total | 6,403 | 6,659 | 6,375 | 7,715 | 7,915 |

*Does not include part-time employees.

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

All figures reprinted from *The MIT Faculty Newsletter*, Vol. III No. 4, January/February 1991.

Universities and the Technology Enterprise: A Personal Experience in Japan

(del Alamo, from Page 1)

Very early as a graduate student engaged in microelectronics at Stanford, I could not help but notice the spectacular emergence of Japan in semiconductors. I was particularly impressed by the pace of Japanese innovation in the field of

those of the individual engineer, obsession with detail, solid team approach, and excellent first-level management.

At that time, I formulated a hypothesis for the three key ingredients of Japanese

technology enterprise realizes that these are serious flaws that exact a heavy price.

My observations are consistent with the widely mentioned “creativity gap” of Japan. Considerable evidence suggests that whereas Japanese technology is leading in many fields, Japanese scientific contributions are, on average, far less distinguished. As technology becomes more science-based, and Japanese companies begin to enter areas where nobody else has ever been before, the competitiveness of Japan might suffer.

Many fingers point at Japanese universities in particular, and their entire education system in general, as ultimately responsible for this. In fact, my colleagues at NTT were top graduates of Japan’s elite engineering schools. Yet they referred to their university years as a nice resting period after the entrance “examination hell” and before the rigors of corporate life set in on them. In fact, although islands of excellence do exist, the role of universities in Japan seems to be confined to being a finely tuned filter selecting tenacious candidates with extremely good memories for the benefit of the companies that hire them.

In 1986, I carried out a little survey that I reported to my management at NTT. I had noticed an almost total absence of research interaction between my colleagues and Japanese university groups. I sought to document the extent to which this was a trend in the country by looking at an important technical journal in my field, *Applied Physics Letters*. I counted the number of papers coming out of Japanese industrial laboratories that incorporated Japanese university co-authors. My underlying

(Continued on next page)

During my stay of over two years, the keys to Japan's phenomenal success in electronics became obvious to me: extremely hard work, lavish laboratories filled with the latest equipment, sharp targeting, almost complete overlap between the goals of the company and those of the individual engineer, obsession with detail, solid team approach, and excellent first-level management.

compound semiconductors, which were at the core of an exploding telecommunications revolution. Japan appeared to be poised to completely dominate this strategic new technology.

In 1983, I had the luck to visit the newly opened Atsugi Research Laboratories of NTT, the Japanese domestic telephone company, and tour what was probably the greatest single effort in the world in research and development of compound semiconductors. This got me restless again. In 1985, when as a fresh Ph.D. I reported to my research engineer assignment at the Atsugi Laboratories, I was the first foreigner ever to become a regular employee of NTT.

During my stay of over two years, the keys to Japan’s phenomenal success in electronics became obvious to me: extremely hard work, lavish laboratories filled with the latest equipment, sharp targeting, almost complete overlap between the goals of the company and

success in an engineering endeavor:

first, the problem or product at hand is controlled by simple first-order physics that are understandable to a Master-level graduate (this is the working engineering degree in Japan);

second, one or two clear figures of merit are available for the engineer to become obsessed with and for management to monitor progress;

and third, the nature of the effort is technology intensive and requires hard work, patience, concentration, and superior management – the staples of Japan’s excellence.

There were also evident weaknesses: little freedom and no incentive to pursue risky projects, aversion to failure, less than superior command of “the fundamentals,” poor communication with outside groups, tunnel vision or lack of interest in related fields, and inferior understanding of the “bigger picture” – the context of their work. Anyone that has been involved in the

Universities and the Technology Enterprise: A Personal Experience in Japan

(del Alamo, from preceding page)

assumption was that this should correlate with the impact of Japan's universities on research deemed important by its own industry. In the period of time that I examined, the first half of 1986, only 9% of Japan's industry papers fell into this category. The equivalent figure for the U.S. was 26%.

My Japanese experience left me with a sense of cautious optimism about the fundamental strength of the science and technology enterprise in the United States. I believe that this strength derives from:

- the uncompromising quest for excellence of the great U.S. research universities both in research and teaching, and

- their productive relationship with the federal government and U.S. industry.

I am convinced that America's higher education system is the most solid bulwark against a slow erosion of the quality of life in this country as a result of the loss of high-technology markets.

Let me give you something to contemplate, drawing from my current research activities. A number of us at MIT share the dream of harnessing the quantum nature of the electron with the hope of sparking another electronics revolution. The economic significance that this would entail is self-evident. The challenges on our way are enormous.

We are talking about building devices with dimensions comparable to the wavelength of the electron, requiring complex facilities and equipment. A regular healthy level of funds needs to flow to maintain everything working in a safe and productive manner. Our work must take place in close interaction with U.S. industry to keep us relevant and to construct channels for rapid dissemination of our technology and knowledge.

Should we stand by the sidelines and see it all happen overseas where this, and many other high risk, high payoff adventures are national priorities? I think we should rise to the challenge and cement a partnership that has so well served this country in the past.

The Role of Science in Technology Progress: U.S. vs. Japan

A case is made for the fact that modern technology is increasingly science-based, according to a recent patent and publications study of the U.S., Japan, and other Western countries, [F. Narin and J.D. Frame, *Nature* **245**, 600 (1989)]. The study also shows that while Japan is a technological powerhouse, its scientific position is much weaker.

A raw count of patents granted in the U.S. between 1975 and 1985 shows that Japan is highly inventive technologically. In that ten-year period, the share of Japanese holders of U.S. patents nearly doubled from 9.4% to 17.9% of the total. The Japanese authored patents are also highly relevant as they are disproportionately referenced by other patents (37% more than statistically expected).

Narin and Frame also studied the "patent to science linkage" by examining

the number of references that patents make to scientific reports, such as books and articles. The same ten-year period saw a dramatic divergence between the two countries in this figure. While starting at a similar level of 0.2 citations per patent in 1975, by 1985, the science linkage of U.S.-invented patents was twice as great as for Japanese-invented patents. This suggests that although Japanese engineers and scientists may be highly inventive, their inventions are not based on scientific research as much as those from the U.S.

The picture of science in Japan, in fact, looks far less impressive in comparison with the U.S., when one examines scientific papers. On average, an American scientist publishes five times more papers than a Japanese scientist. At the same time, Japanese-authored papers draw fewer references from

other papers, a measure of their relevance to the scientific endeavor.

The authors of this study finish with a provocative conclusion. "The relative weakness of Japanese science carries with it an interesting implication for future developments in technology. Technology is becoming increasingly science-based. The important technologies of today – computers, optics, and biotechnology – are built on a scientific foundation. The patent data show that Japanese technology appears to be less science-based than technology produced by inventors from other countries. The question is, can Japan continue its advances in technology without building a stronger science base to draw upon?"

J. A. del Alamo

**Some Reflections
on the New EECS
M.Eng. Curriculum**
(Grosser, from Page 1)

educationally excellent. Third, a large MIT department will now be admitting the majority of its undergraduates to its graduate program. I, for one, hope this treatment of our undergraduates will change, even revolutionize, the MIT culture.

Three Related Predictions

For the reasons given above, the EECS program should be extremely popular with MIT undergraduates (it is my understanding that this is already proving to be true). However, I question the assumption that most of our undergraduates will need five years to complete the five-year B.S./M.Eng. program. It is indeed a five-year program for students who enter MIT with no advanced credit and who take no more than eight subjects a year. However, the many EECS students who enter MIT with some advanced credit and pick up some additional credit over four IAP's will easily be able to complete the forty required subjects in four-and-a-half years. My first prediction is that four-and-a-half years will become the norm to complete the five-year program.

Moreover, there will be considerable pressure on these four-and-a-half-year students to overload modestly and complete the program in four years. Graduating in four years would avoid the problems of having to move out of Institute housing, of having one's financial support run out, of having to return for only one semester after a summer break, and of not graduating with one's class. I therefore predict that it will be seen as possible to do the five-year program in the standard four years of college and that many students will try and some will be able to manage this.

The possibility of a great professional education in only four years is practically irresistible – the best engineering

education at a bargain price! Thus my third prediction is that the enrollment in Course VI will grow rapidly and very substantially; a fifty percent growth in a few years would not surprise me. There is simply no undergraduate engineering program at MIT at this time which will be able to compete, and I believe EECS

leveled off when our undergraduates became convinced that nearly all MIT departments use computers extensively and that graduates could get jobs using computers after majoring in most other departments.

The one direct step taken ten years ago to limit EECS enrollments was to prevent

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will draw students from the other Schools at MIT as well. When the word gets out to the high schools, there will be an increase in the number of applicants choosing MIT over other colleges in order to major in EECS.

Possible Courses of Action

If this level of growth in EECS enrollments indeed occurs, what can be done about it? Ten years ago when faced with the same situation (although the causes were different), the Institute spent nearly a full year and four faculty meetings (I do not remember any other issue which ever took more than two faculty meetings) to come up with a very complicated and well documented plan which would limit EECS enrollment in the admission letters for incoming freshmen. This plan fortunately never had to be implemented. Because it had a three-year sunset clause, it cannot be implemented now but it could serve as a starting point if this idea were to be pursued. In fact, the EECS enrollments

transfer students from majoring in EECS. In the past few years this has been relaxed. Perhaps this rule should be reinstated. But since only ten to fifteen transfer students a year are being admitted who will major in EECS, this is too small a measure to solve the problem.

It seems to me that the positive way to control the enrollment in the EECS Department would be for the other engineering departments to institute their own combined B.S./M.Eng. programs. There is no need, however, for those departments to use the EECS curriculum model. One path would be to follow the 1989 MIT School of Engineering Long Range Plan to broaden engineering education to include societal, political, global, and professional responsibility concerns. Another important path would be to prepare students with the technical background for the new engineering fields which will develop, because of many factors including the end of the Cold War, in the next fifty years.♣

Letters

To the Faculty Newsletter:

I am writing to acknowledge and appreciate the note on community relations in the January *Faculty Newsletter*. As you noted, the decision by MIT Real Estate to retain Erland Construction, a non-union contractor, to renovate the old Ford Assembly Plant at 640 Memorial Drive seriously eroded the generally positive relationship between the university and Carpenters Local 40 of Cambridge.

I believe that a number of administrators at MIT now consider that decision to have been short-sighted. The project is behind schedule and over budget. Thus the very rationale for the choice – to save money for the Institute – has proved to be unfounded. MIT Real Estate thought it could practice fiscal responsibility and ended up discovering that, once again, you get what you pay for. From a strictly business point of view, union contractors remain head and shoulders above non-union firms in terms of quality, reliability, efficiency, and productivity.

More importantly, the university tried

to save money at the expense of local working people. Even if the Institute had realized a small financial gain, there is no justification for the social irresponsibility that guided the choice. Carpenters Local 40 is very pleased that so many members of the MIT community responded to our argument that local standards were being undermined.

Months of picketing, leafletting, and demonstrations of support from the Cambridge City Council and MIT faculty and students brought MIT and Erland to the table. While Erland was willing to make some overtures, the company was ultimately unwilling to sign a collective bargaining agreement. Erland asked for a special deal in order to defuse the controversy, but our position was and is that Erland had to play by the same rules as every other union contractor in Massachusetts.

We have had ongoing cordial discussions with MIT. It appears very likely that the interior work at 640 Memorial Drive will be done on a union basis. But that agreement is as much a positive step by the tenant as it is a shift in policy by MIT Real Estate. William

Dickson, senior vice-president of the Institute, has assured Local 40 that a series of upcoming major projects will be built with union labor. Mr. Dickson is a sophisticated participant in the construction process and realizes that MIT should make long-term decisions based on quality and durability. There still remain, however, serious concerns on our part as to what the university's policy will be regarding smaller and medium-sized projects.

Carpenters Local 40 is eager to work closely with MIT. The university and the union have both been around a long time and will continue to be around for a long time. It makes little sense to have an adversarial relationship. Once again, we would like to thank the MIT faculty for its assistance in providing support for the principle of social responsibility and moving the overall relationship forward.

Mark Erlich
Business Manager
United Brotherhood of Carpenters
and Joiners of America
Local Union No. 40

LINKS Needs Science Demos

Last term about 90 MIT students were working with the science resource teachers at five elementary schools in Cambridge as part of a program called LINKS. Sorority Kappa Alpha Theta, and fraternities Chi Phi, Zeta Psi, Lambda Chi Alpha, and Phi Beta Epsilon were at Morse, Kennedy, Fletcher, Longfellow, and Graham and Parks schools, respectively. This term the Public Service Center has set a goal of 200 MIT students and eight schools.

The LINKS program is a follow-up to the City Days program which took place in September and is aimed at helping the science program in Cambridge public schools. The students go into the science classes and help the teacher by giving individual attention or allowing the teacher to divide the class into smaller groups. Sometimes they also teach classes or bring in demonstrations to show the children.

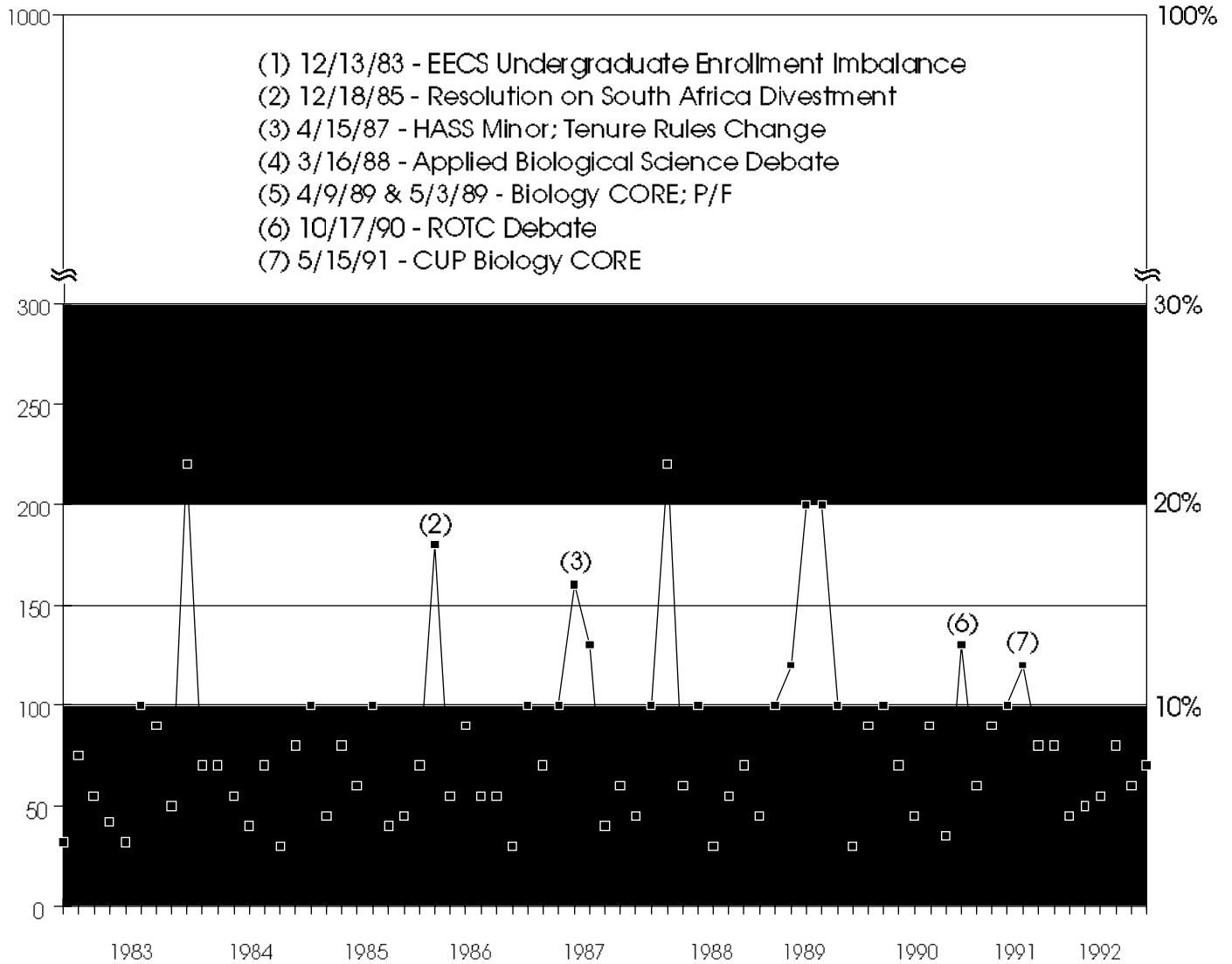
The Public Service Center would like

to compile a database of available "off-the-shelf" science-related demonstrations any professors, laboratories, or departments may have. Such a database would make it easier for the MIT students to acquire and use these demonstrations. Anyone who has any or knows where one or more might be located is asked to please call Virginia Sorenson at the Public Service Center at x3-0742.



M.I.T. Numbers

Attendance at Faculty Meetings (1983-1992)



Plot shows faculty attendance and approximate fraction vs. date of meeting.