

REPORT
OF
The Committee
on Educational Survey

TO THE FACULTY OF
The Massachusetts Institute of Technology

PUBLISHED BY
THE TECHNOLOGY PRESS
of the Massachusetts Institute of Technology
Cambridge, Massachusetts
December, 1949

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Chapter III

A Broader Educational Mission

In reviewing the educational program at the Institute, we have had to consider the emphasis that should be given to education at different levels on the one hand, and in different fields on the other. The first problem was discussed in Chapter II and the second is the subject of the present chapter.

A réévaluation of the present scope of the Institute's educational activities in various fields and a consideration of new educational opportunities that have arisen as the result of the needs of present-day society have led us to conclude that there are compelling reasons for the Institute to undertake a broader educational mission in the future. We shall define this mission as we see it, and we shall consider how it can be accomplished in a manner consistent with the principle of limited objectives that has always been a source of strength to the Institute. We shall also suggest evolutionary changes in the present school structure as a means of contributing to the achievement of the broader mission.

FOR MORE THAN HALF A CENTURY, M.I.T. was renowned as a school of engineering with which was associated a distinguished, but largely autonomous, school of architecture. The majority of its graduates during this period were clearly destined for industrial pursuits, and every effort was made to give them an education that emphasized direct, practical applications to industry.

The primary purpose of instruction in mathematics and physics was to provide a substantial foundation for subsequent engineering studies. In large measure this was also true of chemistry, although the direct applications of the principles of chemistry to industrial processes were recognized. Geology provided basic material for the then extremely important course in mining engineering. Biology was distinguished for its applied aspects, such as public health and industrial microbiology. The natural sciences were valued for their educational utility as a foundation for engineering or for their contribution to the practical arts. Thus, the more the natural sciences resembled engineering in their creative activities, the more they were respected in the practical engineering school environment.

English, history, modern languages, and a scattering of general studies have always been a part of the Institute's curriculum, and economics has been taught since Walker's day. But these subjects were offered primarily to broaden the education of engineers; they were not regarded as fields in which creative development should be a primary concern.

From the beginning architecture has had a distinguished career. The School of Architecture was considered to be outstanding quite independent of its association with an engineering school. This very fact set it apart and caused it to be regarded as a curious anomaly, almost as though some accident of fate had led it to prosper simultaneously with a technological institution to which it was tied through administration but not in spirit.

The foregoing situation was natural and perhaps desirable during the period in which the Institute's primary problem was that of establishing itself in the engineering field, for it permitted the concentration of resources and energies upon the attainment of that one goal. Nevertheless, the complete subordination to engineering of all fields except architecture contributed to the narrowness of outlook and lack of professional breadth discussed in Chapter I as characteristic of one period of the Institute's history.

The Compton administration recognized that weakness in fundamental as contrasted with applied aspects not only handicapped the natural sciences, but also retarded the attainment of full stature in engineering; steps were therefore taken to strengthen fundamental scientific inquiry at the Institute, particularly in physics. Further attention was also given to improving the status of the humanities and social sciences. These trends marked the widening of our educational horizon, but they were modified or interrupted to a considerable extent by World War II. The aftermath of the war has created new problems and has brought new opportunities for educational leadership by the Institute. A reassessment of the desirable scope of the Institute's activities has therefore become essential in this postwar period.

We believe from such a reassessment that the time has come for full acceptance by the Institute of a broader educational mission; a mission that involves pioneering and leadership of a higher order not only in engineering but also in the three other fields, namely, the natural sciences, the humanities and social sciences, and architecture and planning. We believe, further, that this goal must be achieved without departing from the philosophy of limited objectives that has contributed to the strength of the Institute in the past.

Principle of Limited Objectives

Three important policies have been followed in choosing fields of educational activity at the Institute throughout the years, and we believe that a broadening of our educational program can be undertaken now in a manner consistent with the principle of limited objectives if we continue to be guided by these policies. *First*, in accordance with Rogers's belief in the dignity of useful knowledge, the educational program has been designed at all times to fit men for direct contribution to the needs of the society of their day. *Second*, effort has been limited to fields that could

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contribute to or profit from an environment in which the predominant concern is with science and technology. *Third*, major activity has been confined at all times to those fields in which there appeared to be opportunity for the Institute to use its resources effectively.

The policy of designing the educational program to fit men for direct contribution to current social needs has led the Institute to be dynamic, sensitive to the shifting interests and needs of society, responsive to economic and technological changes, and ready to pioneer in new ventures or to support newly discovered talent. If we are to follow this policy consistently, we must be ready to respond to new needs in the society of today.

The policy of limiting effort to fields that could contribute to or profit from an environment in which the predominant concern is with science and technology has prevented the possibility of a progressive broadening of activities toward the all-embracing scope of a university. Thus, law, medicine, and the classical languages, to cite a few from many possible examples, are fields or subjects that would clearly be excluded from the Institute's program by the application of this criterion.

The policy of confining major activity to fields in which there appeared to be opportunities for the Institute to use its resources effectively has insured against disorderly growth or unwise expansion followed by financial difficulties. This policy has also caused old enterprises to be discontinued when they had ceased to serve a useful purpose, thus permitting new ventures to be undertaken without undue over-all expansion.

Our recommendations for the acceptance of a broader mission in the fields of engineering, science, the social sciences and humanities, and architecture involve the corollary that these changes must be brought about in a manner consistent with the foregoing policies.

Four Fields of Activity at M. I. T.

The Field of Engineering — The Institute has always been outstanding in the field of engineering and it is obviously desirable for it to maintain this leadership. But if we are to offer outstanding engineering education in the present era, revision and improvement of the whole educational program are necessary. We recognize especially a need to develop a broader type of professional training that will fit engineers to assume places of leadership in modern society, and we believe that this can be accomplished in part by improvement in the professional subjects themselves, and in part through further strengthening of the natural sciences, the social sciences, and the humanities.

The modern engineer is a servant of the public, which measures his success not by his scholarship but by strict standards of performance. He is responsible for the

safety of people, and his activity often has direct bearing on the welfare of large groups of individuals, whether in his own employ or as a part of his society. His decisions and actions must be subject, also, to the limitations imposed by economic considerations.

Like the physician, the engineer cannot always defer action until all facts in a given situation are fully known but must work within the limitations of the state of the art at any given time. Even in the absence of complete information, it is necessary for the engineer to make decisions with respect to the merits of several alternative possibilities. It is through this ability to make critical judgments that the engineer's professional competence often finds its highest expression.

The professional background that the engineer absorbs during his years of training, and adds to according to his ability during his active years, consists in part of basic science, in part of practical information related to the state of his art, in part of the technique of applying basic science to engineering problems, and in part of the development of broad interests that will lead him to be effective in his relationships with his fellow men. The competent professional man must master all of these elements within his field.

It is essential that the modern engineer be able to organize and direct men. His success depends as much upon his understanding of human relations and his skill in handling men as upon his technical competence. Full achievement in his profession requires that he be a man of broad culture with a deep sense of social responsibility.

In order to train leaders in the engineering profession today, it is not enough, therefore, that they be taught by competent professional men who offer instruction of the highest quality. It is essential, also, that they be given a broad appreciation and understanding of the natural sciences and of the social sciences and humanities. We believe that this objective can be fully achieved only in an environment in which active, creative work, of professional stature, is being pursued in these other fields as well as in engineering.

The Field of Science — Unlike engineering, the natural sciences are not motivated by immediate utility. But when science ranges from the abstract toward the applied, and when engineering shifts its focus from immediate applications to underlying principles, the two fields merge in a borderland area in which it is impossible to distinguish one from the other. Thus many of the great advances in engineering depend on the merging into it of science, through this borderland.

In order for science to contribute to the borderland area, and thus for engineering to progress as a result of the progress of science, it is essential that the more creative and abstract aspects of science continually forge ahead in the direction of the new,

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and hitherto unexplored. Strengthening of engineering by science is best achieved if the environment is such that science can be preëminent in its own right.

Engineering can contribute to science in numerous ways: (1) by the provision of facilities that open up new possibilities for exploration, (2) by directing attention to practical needs that may suggest the investigation of unexplored aspects of natural phenomena, and (3) by inspiring a sense of satisfaction among scientists when practical uses are demonstrated for the various developments that arise from fundamental science in its more abstract aspects. Thus there are distinct advantages to the development of the natural sciences in association with engineering.

There are also disadvantages to the close association of engineering and science. An atmosphere in which practical applications are emphasized may lead scientists to become preoccupied with immediate and utilitarian problems at the sacrifice of attention to fundamental explorations of the unknown. Scientific inquiry often leads along a tortuous road, full of misadventures and disappointments, from which it is tempting to turn aside into the greener pastures of design and development.

Despite the remarkable strengthening of the natural sciences at the Institute since the early thirties, there is still criticism of the extent to which applied rather than fundamental aspects are stressed. Much of this criticism may be unjustified, but we believe that it has sufficient basis in truth to indicate that there is a major challenge to meet in achieving the preëminence in the more fundamental aspects of the several natural sciences to which the Institute should aspire. The present time seems to be an opportune one in which to face this issue since the decline in European science as a result of World War II places a particular responsibility upon American institutions to increase their contributions to fundamental as contrasted to applied science.

We believe, therefore, that more effective means must be found for attracting the most able scholars in the field of science and for providing them with an environment favorable to contemplative effort and free from harassing pressures toward the achievement of practical goals. As the first step, we suggest that still greater opportunity be given for the development of the natural sciences in their own right.

The Field of Humanities and Social Sciences — In addition to new aspects presently under development or that may be developed in the future, we include in this field the various humanistic, cultural, and social studies now concentrated in the following departments or groups: Economics and Social Sciences, Business and Engineering Administration, English and History, Modern Languages, and the Institute libraries. It is by no means conventional to group these various individual categories together in a single field. Nevertheless it is our opinion that, in

an environment such as that at M.I.T., which is strongly influenced by science and technology, there is sound reason for such a grouping in order to achieve a focusing of attention on the mastery of the problems arising from the impact of science and technology upon society.

Modern trends have greatly augmented the importance of this broad area. In our increasingly complex society, science and technology can no longer be segregated from their human and social consequences. The most difficult and complicated problems confronting our generation are in the field of the humanities and social sciences; since they have resulted in large measure from the impact of science and technology upon society, they have an intimate relationship with the other aspects of the M.I.T. program. As a scientific and technological institution, M.I.T. has obvious and challenging opportunities in this area: the opportunity to make a larger contribution to the solution of urgent social problems, the opportunity to help prospective scientists and engineers to understand better the forces that are molding contemporary society, and the opportunity to give students of the social sciences and the humanities a better insight into the meanings and implications of science and technology.

No one can now chart with precision a detailed course to follow in meeting this challenge. We believe the first step is to provide greater opportunity for scholars to undertake creative work in this field at M.I.T. at the same high professional level as that characteristic of other fields. By encouraging full development of the field as an important one in its own right, rather than as one that is chiefly useful as a service facility for other professional groups, we believe that the quality of education in the humanities and social sciences at the Institute can be improved materially.

The Field of Architecture — Architecture deals with the physical environment of people. It includes the planning of the physical environment for both living and work, and in this and other respects is both influenced by and has its influence upon engineering. In its development of new methods for handling the physical environment, it leans heavily upon both engineering and science. It involves both utilitarian and aesthetic motivations.

Education in architecture has been a feature of the Institute since its founding. During a portion of the earlier years, the emphasis in architecture was upon the aesthetic rather than upon those aspects that merge into engineering or depend for their strength upon science. During this period the School of Architecture was far less closely integrated with the rest of the Institute than it is today. In recent years, the focus has shifted to include various aspects of architecture and planning that are closely allied to science and engineering. Increased emphasis has also been given

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the solution of environmental problems arising from the impact of science and technology upon everyday living and working.

Thus architecture as presently constituted derives much of its strength from the areas of engineering and science. In turn, in its close association with these latter areas, it affords an opportunity for engineers and scientists to broaden their cultural and general backgrounds.

The increasing population and the growing complexity of such technological aspects of living as transportation and communication require ever greater concern with the planning of the environment that man creates for his working and leisure hours. Hence, we foresee great opportunities for the field of architecture and planning at M.I.T., where it can be closely associated with engineering and science on the one hand and with the investigation of social and cultural problems related to science and technology on the other.

We believe that the School of Architecture and Planning would benefit from the strengthening of the humanities and social sciences that we have already suggested. We also believe that it would benefit from a more widespread recognition by the whole faculty of the fact that it is not only a school of equal status with the others at the Institute, but is closely integrated with them in many of its interests and activities.

Four Schools

Together these four fields constitute an appropriate range of educational and research activity for M.I.T. Each one has important common interests, problems, and objectives that distinguish it from the others. We believe that the time has come for the Institute to permit the activities within each of these fields to develop in their natural directions. We believe that it is consistent with its long tradition of leadership for the Institute to take advantage of the new opportunities in these areas, and that if this is done in accordance with the policies for choosing activities that have been discussed previously, a proper limitation of over-all scope and diversity will be retained.

Two steps are necessary to accomplish this broader mission. *First*, means must be provided for developing a community of interest, an enthusiasm for stimulating creative activities, and a united concern with common problems in each of the four fields. This can best be achieved through evolutionary changes in the school organization that will focus attention upon the common objectives and problems of each field. *Second*, the field of humanities and social sciences must be given a status equivalent to that of the other fields. This can be achieved by establishing a fourth school, that of Humanities and Social Sciences, in addition to the present Schools of Engineering, Science, and Architecture and Planning.

We recommend that the School of Humanities and Social Sciences be established at once. We recommend further, as a means of focusing attention upon common problems and objectives in each area, that each academic dean appoint an advisory council to include all department heads within his school and such other members as he may wish. Each council should meet with its dean regularly to discuss objectives and educational problems in the field of the particular school, in accordance with the over-all plan for developing educational policies that is discussed in Chapter V.

The representatives of a school would advocate to the faculty proposals that had been worked out carefully in the school council and perhaps even considered by all the faculty members in that school, but the final decision would rest with the unified faculty. In theory, the vigorous efforts of the school groups might lead to a division of the Institute into four autonomous educational and research areas. In practice, we see no danger of such a contingency, since there would continue to exist strong forces directed toward preserving the unity of the Institute's educational program, operating through the unified faculty of the Institute, which would retain sole power to act on all major proposals of the schools.

The Educational Value of the Four-School Plan

The growth of the Institute since 1900 and the increase in the number of departments and courses has made necessary, in our opinion, some sort of grouping of the departments into larger units if educational planning is to be most effective. If this grouping be considered solely from the point of view of administrative convenience, there is no compelling logic that leads one inevitably to schools of science and engineering, for example. An argument certainly can be made for the grouping of a basic science with its immediate fields of application. This arrangement was followed for chemistry and chemical engineering at M.I.T. for many years. Such groupings as mathematics, physics, and electrical engineering, or geology, metallurgy, and mining engineering, have also been used. Any such organization can be made to operate effectively, under good administration. Factors other than manageability enter into this problem, however, and the kind of grouping that has naturally developed at M.I.T. is a sound one for reasons of educational policy as well as administrative efficiency.

The subject matter of physics and electrical engineering, of chemistry and chemical engineering, or of biology and sanitary engineering, is in some respects identical; but in spirit, in method, in objective, and in its ethical relationships to society, science is sharply distinguished from engineering. The school organization that we propose to strengthen at M.I.T. is based on this kind of difference between departments. We believe that it is a good kind of organization. It seems to us an

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...by encouraging a greater unity of objectives among the departments constituting the school, and by giving the schools a greater responsibility for undergraduate education, we can meet the common criticism that undergraduate education at M.I.T. is overspecialized. The Institute now offers twenty professional curricula to undergraduates, and a number of these are further subdivided into options. This proliferation reflects the growing complexity and scope of science and engineering. We question, however, the wisdom of attempting to reproduce in our undergraduate curricula the fine structure of the modern technological world. While fully recognizing the educational value of a certain amount of undergraduate specialization, we believe that M.I.T. in its undergraduate school is devoting too much attention to details peculiar to civil or mechanical engineering, for example, and not enough to the principles, methods, and values that are common to all branches of engineering.

We believe, then, that M.I.T. should work toward the ideal of offering essentially four principal types of undergraduate education rather than twenty, and we expect that an increased emphasis on educational planning and leadership in the schools as distinct units will lead to a greater differentiation among the types of education offered by the schools, and less differentiation among the undergraduate courses within each school.

Responsibilities of the School of Humanities and Social Sciences

We have recommended that a School of Humanities and Social Sciences be established on an equal footing with the existing schools at M.I.T.; we recommend further that the advancement of knowledge be considered an essential part of its program, that it assume the responsibility for planning and administering the program of general education as a part of the common curriculum, and that it offer professional courses leading to graduate as well as undergraduate degrees.

A primary responsibility of the school will be productive scholarship in fields logically related to the Institute's activities. We see great possibilities for the development within this school of a center for creative work in the field of social technology and for the study of the relation between science and technology on the one hand, and man and his institutions on the other. The field need not be strictly defined. It will grow and change as have the other fields at the Institute. The impact of technology upon society is so far-reaching that every member of the staff of such a school can find an area within which he can contribute significantly to the scholarly output of M.I.T.

The school will serve the Institute by planning and administering a general educational program for all M.I.T. students, designed to develop an awareness of the interrelations of the scientific, technical, and literary cultures, and a sensitiveness to the diverse forces that motivate the thoughts and actions of people. This general educational program, like all components of M.I.T. education, will grow out of the creative work of the departments, and it must be an integral part of the professional curricula. We ask for more than a mechanical mixture of the conventional literary and technical cultures. We ask for an integration of general and professional education suitable for the M.I.T. environment.

The professional curricula leading to degrees, graduate and undergraduate, will include the present Courses in Business and Engineering Administration and Economics and Engineering. New courses will undoubtedly be developed in this school as they have in the others when the need for new kinds of professional education arises, when new resources become available, and when the creative work of the staff makes clear to the unified faculty the desirability of such expansion.

Conclusions and Recommendations

1. We conclude that in choosing its activities the Institute should continue in the future the three policies it has followed in the past, namely:
 - (a) A devotion of primary effort to education aimed at fitting men for direct contribution to the needs of the society of their day,
 - (b) A limitation of effort to fields that can contribute to or profit from an environment of science and technology, and
 - (c) A concentration of activity in fields in which the Institute can use its resources most effectively.We recommend that these policies be followed in broadening the Institute's educational mission.
2. We conclude that the four general areas of Engineering, Science, Architecture and Planning, and the Humanities and Social Sciences are appropriate ones for education and research at M.I.T. We believe that M.I.T. is now in a position to make outstanding contributions to education and the advancement of knowledge in each of these four fields. Together these four fields make a good academic community for a cooperative attack on vitally important problems and a good educational unit for the development of leaders for a technological world. To enhance their effectiveness, we recommend a general strengthening of the school structure. We also recommend the appointment by each academic dean of an advisory council to consider with him the common objectives and problems of his school.
3. We conclude that the strengthening of the school structure will contribute to the development of the educational program, especially at the undergraduate

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el. We recommend that undergraduate education be directed toward diversity ased primarily upon four fields rather than upon twenty courses.

We recommend the immediate establishment of a School of Humanities and Social Sciences with responsibility for:

- (a) Creative professional activity,
- (b) Provision of a program of general education for the whole Institute, and
- (c) Advanced education leading to higher degrees.