WILLIAM BARTON ROGERS' CONCEPTION
OF AN INSTITUTE OF TECHNOLOGY

by

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ABSTRACT

The nineteenth century witnessed a revolution in education -- a dramatic turning away from the ideas and methods of the classics to those of the rapidly developing science and engineering. As the advancements of the previous two centuries in the sciences and crafts were multiplied and compounded, the need for people trained in the new ways became increasingly demanding. Western civilization, in the thrall of advancing technology, began to strain under the pressing need for great numbers of competently trained technical personnel. No longer was the slow, laborious apprenticeship process adequate. Consequently, schools devoted to instructing in the concepts and methods of the sciences and crafts, and resembling in organization the schools of the classics, were established. What was to be the educational policy of these schools and their relation to the society of which they were part? The answers to these questions were formulated and put into practice by William Barton Rogers, the founder and first President of the Massachusetts Institute of Technology, and a brilliant American scientist of the nineteenth century. The object of this study is to set forth Rogers' answers in terms of their historical development.
PREFACE

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CHAPTER 1

INTRODUCTION

The Historical Setting

The technological university of today finds its origins in the very heart of the Scientific Revolution and of its successor, the Industrial Revolution. The double emphasis of experimental method coupled with theoretical thought, which is considered necessary in the teaching methods of these schools, finds its beginnings with Galileo, Harvey, and Newton. Although these great men did their outstanding work while associated with famous classical universities, their scientific endeavors seem to be incidental to their professorships. The history of the scientific revolution seems to lie for the most part outside of the universities of the time.

In the middle of the seventeenth century, the method of scientific inquiry began to attract the attention of interested men in Europe. The Royal Society of London traces its history to the time of Newton's youth, and the Paris Academy was endowed in 1671. By the eighteenth century the spirit of science had captivated men's minds and hearts. The mysteries of the universe were unfolding at the discovery of scientific laws. Also, it was an age of invention. Newcomen's steam-pump, Arkwright's spinning frame, Watt's steam engine and numerous other devices increased production and wealth. Scientific investigation became
the hobby of gentlemen, with clubs and societies being founded for the purpose of advancing scientific inquiry. Public lectures on scientific subjects became immensely popular, especially in France and England. A few academies began to offer scientific training, and in 1794 the Revolutionary government of France established the Ecole Polytechnique. By 1800, France was the established center of scientific inquiry and experimental research. But, the classical universities shared little of this enthusiasm for science.

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Our attention now turns to a well-to-do family of the gentry of northern Ireland, Rogers, by name. In 1776, the year of American Independence, there was born to Robert Rogers, Esq., and Sarah Kerr Rogers, a son, the eldest of twelve children, Patrick Kerr Rogers, by name, who would be the father of William Barton Rogers. The early education of Patrick Kerr Rogers was under the supervision of an aunt, who was reputed to be a woman of notable intelligence, and well aware of the trend of the times. His family encouraged him to enter the ministry, but, instead he entered an accounting house in Dublin. During the Irish rebellion of May, 1798, he wrote newspaper articles hostile to the British government and was forced to flee to America, where he arrived in August of 1798.

In a few months Patrick Rogers became a tutor at the University of Pennsylvania. In the winter of 1799 he was admitted to the Pennsylvania Hospital, the medical school of the University, where he studied under the eminent Doctors Benjamin Barton, his preceptor, and Benjamin Rush, the signer of the Declaration of Independence, himself an immigrant from Ireland. These two men, Barton and Rush, were noted for their emphasizing the practical
arts of ministering to the sick, such as the setting of fractures, etc., as being of equal importance with the rote aspect of learning diagnosis.

Patrick Rogers married on January 2, 1801, to Miss Hannah Blythe, and four sons were born to them, by name -- James Blythe, William Barton, Henry Darwin, and Robert Empie, all of whom were eminent in the annals of nineteenth century American science.

Dr. Rogers received his degree of Doctor of Medicine in May of 1802 and practiced in Philadelphia and Baltimore during the years from 1802 to 1819. During these years he delivered many lecture courses on chemistry and natural philosophy.

He was a personal friend of Thomas Jefferson, and followed the development of the nascent University of Virginia with animated interest. As a professorship was not available for him at the University of Virginia in 1819, Dr. Rogers accepted the position of Professor of Natural Philosophy and Chemistry at the College of William and Mary. Dr. Rogers was wont to illustrate his lectures with demonstrations and models. He built all of the necessary equipment himself, with the eager assistance of his adolescent sons. Dr. Rogers supervised the education of his sons himself, and according to their testimony it was he who inspired them with their great love of science. During his seventeenth year, William became noted for an outstanding oration at the "Third Virginia". As he approached the age of twenty, he demonstrated a remarkable grasp of languages and the sciences as well as a remarkable ability for self-application.

Due to a want of good text books available in English or French for his younger brother, Henry, William undertook to translate the appropriate master works from their original tongues, oftentimes Latin and Greek, and to instruct Henry according to these
translations. In this way an extremely intimate relationship grew up between these two brothers of an already closely-knit family. The talents of the young William came to the attention of the aged Jefferson at this time and in all probability the gaze of the elder former President fell upon him.

For a brief time William was engaged in lecturing and elementary teaching at the Maryland Institute in Baltimore.

At the death of his father in 1828, William succeeded to the Professorship of Natural Philosophy and Chemistry at William and Mary. The young Professor Rogers was very successful as an instructor. Well-liked, and having a magnificent command of his subject, Professor Rogers also had in his father a worthy example as a pedagogue. According to Dr. Patrick Rogers, the great ends of the education of every human being were "to promote the happiness of the individual, to raise him to the higher standard of worth and excellence, to render him not merely a harmless but a valuable member of the community of men, to give him the disposition and the power to be useful to his companions in the frequently difficult and cheerless journey of life, and to prepare him for the happiness of a future world...".

During the winter of 1831-32, Henry became attracted to the views of a group of social reformers known as the "Fourrierists". With the reluctant consent of his brother, William, he sailed to England in May of 1832, so that he might be able to study their ways further. Instead, while in England he came into contact with the British Association for the Advancement of Science, which had been formed just the year before. This group, which included in its membership most of the great English scientists of the time, welcomed him warmly and gave great stimulation to his scientific propensities. Henry returned to the United States in the summer
of 1833, having formed many fast friendships among the British scientists. His affiliation with the British Association afforded both to himself and to William an intimate contact with British science which was to remain intact for more than thirty years. It was through this organization that Professor Rogers first learned of the scientific universities and Technische Hochschulen of Germany. The purpose of the scientific universities was to explore and expand scientific principles and practices. Their great concern was for investigating the phenomena of the pure sciences. Almost no thought was given to applying these principles to the practical arts and the crafts. On the other hand, the Hochschulen sought to train craftsmen and engineers in the methods of the practical arts, emphasizing the application of scientific principles.

In 1835, Professor Rogers was appointed Professor of Natural Philosophy at the University of Virginia, and he held this post for eighteen years. The University of Virginia was founded by Thomas Jefferson, and was permeated by his revolutionary educational ideas. It reflected his spirit in political creed, in freedom from every form of sectarianism, and in complete dedication to the advancement of science. Jefferson believed that the ultimate power of government rested in the hands of the people at large and that they as a body are representative of virtue and wisdom. Although he did not have high regard for primary education, he believed that it is safer to have a whole people respectably enlightened, than a few in a high state of knowledge and the many in ignorance. Jefferson did not give the smallest consideration for any religious dogma or doctrine in the founding of the University and furthermore, was hostile to every form of tyranny over the minds of men.

The University was intended to be the center of a statewide
system of schools adapted to all levels of education. It was to have roundness and completeness in each of its schools with an emphasis upon the natural sciences and technical philosophy. Rogers, by his own admission, was influenced by Jefferson's example. However, he did not share Jefferson's narrowminded disdain toward the study of English and geology.  

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On June 12, 1842, William and Henry received notice of their election as honorary members of the Boston Society of Natural History. The same year, the annual meeting of the Society of American Geologists and Naturalists was held in Boston. Traveling to Boston to deliver their paper on Appalachian geology, the two brothers got their first sight of New England, which at that time was the cultural center of the country. Being men of eminence in science, they were received into the highest circles of Boston society and made a number of important acquaintances.

Returning to Boston late in 1843, Henry delivered a lecture course on American Geology. The following May, he was asked by Mr. J. S. Lowell, Trustee of the Lowell Institute to deliver a course of lectures before that Institute in Boston.

At the opening of the University of Virginia in the autumn of 1844, Professor Rogers was chosen Chairman of the Faculty, the highest administrative post at the University. During his tenure of a year, Professor Rogers had to deal with very severe student riots. Shortly thereafter he found awaiting him the task of dissuading the Virginia legislature from withdrawing their annuity from the University. In his memorandum to the legislature, Rogers pointed out a number of new educational policies which set the University apart from its many sister institutions. This important little document, written in 1845, includes a large part of William
Barton Roger's educational philosophy. The student at the University was allowed to select those studies which had more immediate reference to his intended life-work, be it in science or letters. Also, the use of oral lectures and text books was integrated so as to stimulate the interest and enthusiasm of the student. There was a heavy emphasis on originality of thought, keenness of discernment, and depth of understanding. This stimulating atmosphere thwarted drudgery and encouraged earnest scholarly pursuit. The degree granted by the University was the sign of a worthy achievement. These experiences at the University of Virginia were to stand Professor Rogers in good stead for his future efforts in Massachusetts.
FOOTNOTES

1. Ashby, (Sir) Eric - Technology and the Academics

2. After Dr. Barton of the University of Pennsylvania medical school.

3. After Erasmus Darwin, grandfather of Charles Darwin.


6. Upon describing systematically the geology of the Appalachians William and Henry Rogers became the first great American geologists.
CHAPTER 2

THE GERMINATION OF THE IDEA

In a letter dated March 8, 1846, Henry writes to William:

"Mr. Lowell, ..., after mentioning the feature in the Lowell will which enjoins the creation of classes in the Institute to receive exact instruction in useful knowledge, requested me to give him, in writing, the views I had just been unfolding of the value of a School of Arts as a branch of the Lowell Institute. My communication to the corporation has, I am sure, made an impression on him, and it is possible he has seen, by what is there stated, the importance of teaching science in its applied forms in this community. He is a very cautious man...; but he sees (the value of attaching a practical College to his Institute), and now is a fine occasion to inspire him with the zeal which he is quite capable of feeling in its behalf. His plan would be to teach the operative classes of society, - builders, engineers, practical chemists, manufacturers, etc.; to admit in the first year only in limited numbers, and to teach them regularly; to have perhaps, two permanent and salaried professors at the head of it, and to make up the rest of the instruction by assistants and by teachers, ... How much I want you near me at this time to aid me in digesting and submitting my views on this important scheme to Mr. Lowell!

"... Can you send me a copy of our memorial on behalf of the Franklin Institute for a School of Arts?... what is better yet, give me your ideas in a letter... Take Robert into counsel, and draw up a scheme of study: enumerate the things to be taught, the nature of the apparatus for instruction aiming at economy and show me your ideas of the value of science in its great modern application to the practical arts of life, to human comfort and health, and to social wealth and power."
This letter marks the very beginning of M.I.T. history. It was this letter which gave the keen mind of William Barton Rogers the impetus to think specifically concerning a polytechnic school in Boston, and which communicated the practical desires of the cautious trustee, Mr. Lowell, to the idealistic thought of Rogers. As is evident in the letter, this invitation to discuss a school of practical sciences in Boston did not imply that the founding of M.I.T. was imminent. The proposed school, if it were to be founded - and that was far short of certainty - would be a section of the Lowell Institute, and not independent of outside educational administration, as M.I.T. was to be.

In the lengthy return letter of March 13, 1846, Professor Rogers stated his proposals for a polytechnic school in Boston. In this letter Rogers laid much of the basic foundation concerning his thoughts on establishing a technical school in Boston. In his answer, he was concerned with reasons why Boston was the best available location for the proposed school. He pondered also the interrelated questions of what subject matter should be taught, how to teach it, and to what classes of people he intended to offer instruction. How should his trainees be prepared for their vocations, and what facilities should be available to them? All of these questions would assume importance in the petition of fourteen years later to the general court of 1860. The one question which did not arise at this time was concerned with the affiliation of the proposed school with other institutions. It was presumed that the school would be affiliated with the Lowell School.

Rogers thought that Boston was the leading industrial and cultural center of the United States, and therefore would be the best possible location for the proposed Polytechnic School. He remarked, "Ever since I have known something of the knowledge-
seeking spirit, and the intellectual capabilities of the community in and around Boston, I have felt persuaded that of all places in the world it was the one most certain to derive the highest benefits from a Polytechnic Institution. The occupations and interests of the great mass of the people are science, and their quick intelligence has already impressed them with just ideas of the value of scientific teaching in their daily pursuits."

Rogers thought that a school of practical science should educate its students according to the methods of the practical arts and the crafts. But, rather than being a trade school, it should give the student a background in science which would allow him to approach the practical arts from an enlightened point of view. Professor Rogers desired that his students should have a solid grasp of the scientific reasons for performing the tasks of a tradesman or engineer, and that they should be capable of evaluating these operations and of proposing new and improved methods in the light of sound scientific thought. Professor Rogers recommended that the School include two departments: one which would seek to give the student a broad and solid foundation in general physics, including chemistry, and the other, which would emphasize work in practical chemistry, metallurgy, architecture, engineering, and other branches of the practical arts. The purpose of these two departments would be to inculcate scientific principles necessary for worthwhile work in the practical arts. Laboratories and workshops would provide for the experimental training which could not be had from the lecture room or text book.

Professor Rogers recommended that the lectures on science should be prepared in such a way that they would be of interest and enlightenment to the public at large, as were the lectures of the Royal Institute of London. In this way the proposed school could
serve to communicate recently discovered scientific truths to the artisans and practical men who would find them useful.

"A polytechnic school, therefore, duly organized, has in view an object of the utmost practical value, and one which in such a community as that of Boston could not fail of being realized in the amplest degree." 2

The next words of Rogers have the ring of true prophecy about them,

"In a word, I doubt not that such a nucleus-school would, with the growth of this active and knowledge-seeking community, finally expand into a great institution comprehending the whole field of physical science and the arts with the auxiliary branches of the mathematics and modern languages, and would soon overtop the universities of the land in the accuracy and the extent of its teachings in all branches of positive knowledge."

At the conclusion of the school session at the University of Virginia in June of 1846, Professor Rogers travelled to Boston and visited briefly with his brother, Henry, who was then Rumford Professor at Harvard. During the latter half of his visit he was entertained by Mr. James Savage, his future father-in-law.

The proposed Polytechnic School never achieved fruition, because the Trustee was not permitted by the will to use the funds of the Lowell School for such an enterprise. The following year saw the founding of both the Lawrence Scientific School at Harvard and the Sheffield Scientific School at Yale. Although these two schools specialized in both the theoretical and applied sciences, they were governed by the severe restrictions of their respective universities and did not have the necessary facilities or proper method for thorough instruction in this subject matter. They were still considered very much under the wing of their respective universities and bound to the old methods. They provided a measure of scientific
education, but failed to meet adequately the needs of the country for men properly trained in the technical arts.

In June of 1849 Professor Rogers was married to Miss Emma Savage, the daughter of Mr. James Savage of Boston. During the summer of that year he and Mrs. Rogers travelled in England, where he made the acquaintance of many of his brother's scientific friends, and on the continent of Europe, where he visited the University of Heidelberg. He retained his Professorship at the University of Virginia until the spring of 1853. Resigning in 1853, after eighteen years of service, he took up residence in Boston at the home of his father-in-law. In 1857 Henry Rogers resigned his professorship at Harvard to become Regius Professor of Science at Edinburg University in Scotland. The years between 1853 and 1859 find Professor Rogers delivering lecture courses in the several branches of science before various societies and clubs in Boston and New England. During this period, he became highly respected in Boston as a man of science and letters.
FOOTNOTES

1. In 1837, Professor Rogers prepared for the Pennsylvania legislature a memorial concerning the Franklin Institute in Philadelphia. Although no copies of that document were available it seems that it had some bearing on the nature of the document which Professor Rogers prepared for his brother, Henry, in March of 1846.

2. In this sketch of a polytechnic school, we can see two of the three main features of the M.I.T. of 1865 taking shape. The plan for the School of Industrial Science included (1) a plan for a thorough education in the sciences and practical arts and (2) a plan for general popular education in science. The Society of Arts was intended for disseminating recent scientific knowledge to craftsmen and other interested citizens. The Museum of Arts is not apparent in this document.
In 1859, things began to happen in such a way that it seemed as if the enterprise so brilliantly conceived of thirteen years before would see fulfillment. Part of the Back Bay tidewater basin had been filled under the auspices of the Commonwealth, making available much new land for the expansion of the City of Boston. In his annual message of 1859 to the General Court, Governor Nathaniel Banks remarked that the opportunity was favorable "for the application of (the proceeds of) this property to such public educational improvements as will keep the name of the Commonwealth forever green in the memory of her children."\(^1\)

Acting on this favorable statement, a number of different associations which sought to advance the Arts and Sciences banned together hastily and became known variously as "The Massachusetts Conservatory of Art and Science", "The Associated Societies or Institutions for the Advancement of Art and Science".\(^2\) They drew up a grandiose scheme which sought to obtain a large section of the Back Bay lands for a "Conservatory of Science". This Conservatory if it were chartered would seek to unite the efforts of the Societies involved as well as their collections of scientific material and their building facilities. They drew up a hasty petition to the General Court, which was not granted. Although his name appears among the petitioners, Professor Rogers did not take an active part in this effort of 1859, being away from Boston on a lecture tour at the time.
of the petition. 3

The Conservatory decided to make another petition to the General Court in 1860, and Professor Rogers was asked to write the Memorial for it. In this way was he asked by public-spirited citizens of Boston to undertake that project which would culminate in the establishment of the Massachusetts Institute of Technology.

Professor Rogers came to this new labor with remarkably complete advanced preparation. Trained by his father to a spirit of scientific investigation, he had become one of the outstanding scientists of his time. 4 Coming from a happy and very intimate childhood home, he was an amiable person and easy to associate with. Having been a highly successful teacher and lecturer from the days of his early manhood, he was capable of making himself understood even to the most uneducated person. From his days at William and Mary and the University of Virginia, he was imbued with a liberal spirit favorable toward scientific education. He had thought long and deeply on the possible worth of formal technical education in Boston. Finally, in Boston, he had achieved a great popular recognition of his abilities as a man of science, as well as a general public sympathy for his proposed polytechnic school. The time was now ripe for this momentous effort, which would make a very heavy impact upon education in general, and technical education in particular.

A Memorial (Memorial of the Associated Institutions of Art and Science to the Massachusetts Legislature of 1860 Asking for a Reservation of Lands on the Back Bay) was prepared by Professor Rogers and submitted to the General Court during the first days of January 1860. This document reflected back to the statement of 1846, incorporating some of its general ideas about technical education. However, its main thought was to provide lecture courses
along with displays of collected material having scientific and educational value for the benefit of the public at large. The idea of intensive technical education was almost completely sidestepped.

The petitioning body, like its predecessor of the previous year, was a loose federation of associated institutions, having the same overall purposes of general public amusement and edification, and banned together for the purpose of putting a group request before the state legislature. Two of the organizations were already functioning -- the Massachusetts Historical Society and the Boston Society of Natural History. It was proposed to establish two more organizations, a Society concerned with Mechanics, Manufacture, Commerce, and Technology in general, and a Society of Fine Arts and Education. All of these organizations desired concurrent tracts of land, so that they could be closely associated in operation and could integrate their various collections. Each organization was to have a government independent of the others and would have its own limited field of concentration. Each would do experimental and cataloguing work in order to advance the cause of science and art. It was mentioned that the various Societies might sponsor lecture courses on the sciences, but these would be of an experimental and trial nature, such as those sponsored by the Royal Institution of London.

It is uncertain whether or not Professor Rogers had lost sight of his goal during this brief period from January to May of 1860. This Conservatory for which he had written the Memorial to the legislature does not seem to have any definite provisions for the type of school he had described to his brother, Henry, and to Mr. Lowell in 1846, and for which he had apparently been working for the past seven years.

Before the General Court of 1860, the petitioners ran into a
huge roadblock in their attempt to secure a grant of the Back Bay lands. As a result of the governor's address of the previous year, the legislature had assigned the proceeds of the Back Bay lands, about to be put up for sale, to a School Fund, which was intended to give financial assistance to educational institutions in Massachusetts. Having passed the House, the petitioners were unable to convince the Senate that their project would be an educational institution or that their proposed buildings if built would enhance the price of the surrounding real-estate enough not to deplete the revenue anticipated for the school fund. During its deliberation the Senate apparently decided that an educational institution would have to have more specific purposes than the general amusement and enlightenment of the public.  

Professor Rogers remarked bitterly of the Senate's action,

"After delays and reconsideration the Senate have finally refused to grant the Back Bay reservation for which we applied. This result we had not dreamed of while the matter was pending in the lower House, and its great success there made us at first quite confident that it would encounter no serious opposition in the Senate. But meanwhile some enemies of the bill were quietly preoccupying the minds of the senators, so that when the time for the action drew near we found that the narrow financial views instilled into them could not be corrected. Unluckily, the Back Bay lands were last year pledged to the increase of the common-school fund, and we were driven to the narrow basis of argument that our improvement would double the market value of the adjacent lots, and thus not take from the prospective school fund. We brought evidence to show that this would be the effect, but the majority of the senators refused to be convinced. In another year no doubt the measure can be carried, as now its merits are pretty well understood through the State, and we shall have a legislature uncommitted to operate on."

Professor Rogers may have lost sight of his goal temporarily
in the early months of 1860, for he supported the proposed Conservatory with extraordinary vehemence. On the other hand he may have supported the project in the hope that its success would lead to the furtherance of his own desires. It is difficult to tell what his true sentiments were, for, on the one hand he came to the support of the "Conservatory" with great vigor. But, on the other hand, two scant months after the Committee of Associated Institutions had gone down to their stinging defeat, we find Professor Rogers chairman of a subcommittee whose duty was "preparing and reporting the plan of an Industrial Institution designed for the advancement of the industrial arts and sciences and practical education in the Commonwealth." Apparently he still considered such an Institution as properly a part of a larger organization, although this larger organization was merely a loose federation of organizations, for he wrote to his brother, Henry, "Among our (the committee of which he was recently appointed chairman) present purposes is that of framing a plan for a Technological department..." 6

During the months from June to October of 1860, Professor Rogers matured his plan. On September 24, he wrote,

"My last visit to Boston was for the purpose of reading to a committee a pretty full outline of an Institute of Technology, to comprise a Society of Arts, an Industrial Museum, and a School of Industrial Science. My plan is very large, but is much liked, and I shall probably submit it, by request, to a meeting of leading persons in the course of a week or two, after which it will be printed in pamphlet form. The educational feature of the plan is what ought most to recommend it, and will, I think, be well appreciated. It provides for systematic teaching in Drawing and Design, Mathematics, general and applied Physics, Practical Chemistry, Geology and Mining, and would require at least five fully equipped professorships, besides laboratories, even at the beginning. It contemplates two classes of pupils, - those who go through a regular and continuous course of practical studies, and
those who attend the lectures on Practical Science and Art."

Apparently on October 5, 1860, Professor Rogers submitted his plan to the Committee, under the title of "Objects and Plan of an Institute of Technology, including a Society of Arts, a Museum of Arts, and a School of Industrial Science, proposed to be established in Boston", and it was adopted. This plan became the basis of the Massachusetts Institute of Technology.

Initially, Professor Rogers pointed out that the interplay between science and the crafts is the fountainhead of the growing technology. The growth of the industrial schools of Europe was evidence of need for technically trained people on that continent. The need for such an institution in the United States had become apparent, and Boston as the center of industrial enterprise in New England was the best choice for the site of a technical school.

The proposed Institute would be composed of four bodies; three intended for the furtherance of scientific knowledge: namely the Society of Arts, the Museum of Industrial Arts and Sciences, and the School of Industrial Science; and the fourth, the corporation which would be concerned with the government of the Institute. The Society of Arts was intended to be the investigative body of the Institute. It was to be composed of local tradesmen, craftsmen, engineers, and men of science. Its chief purpose would be to investigate natural phenomena and scientific principles, as well as their application to practical science, i.e., the trades and crafts. This Society would be divided into many committees, which would deal with the particular small areas of science and practical arts which were of interest to the members. The Museum of Science would house interesting educational exhibits relating to science and technology. Its facilities would be intended for the enlightenment
of the interested observer with but a little free time.

The School of Industrial Science and Art would give a systematic training in the applied sciences. Rogers insisted that only a person who had systematic training in the applied sciences could have a sure mastery over materials and processes. Curricula were planned in Drawing and Design, Mathematics, General and Applied Physics, Practical Chemistry, and Geology and Mining. Rogers anticipated two classes of students - those who would be subject to progressive systematic training on a full-time basis, and those who could attend lectures on a regular part-time basis after-hours or at night. Neither of these two sets of class schedules were to provide a lecture course for popular entertainment, but were to provide courses which gave a thorough understanding of the principles of science and technology. "The most truly practical education, even from an industrial point of view, is founded on a thorough knowledge of scientific laws and principles, and is one which unites with habits of close observation and exact reasoning a large general civilization (culture)." "The highest grade of scientific culture is not too high a preparation for the labors of the mechanic and manufacturer." "Abstract studies often are the best sources of practical discovery and improvement." Rogers desired that there should be an interplay and a dialogue between engineering and the sciences in his School. He knew that the study of science and letters was a necessary part of the education of a technical man, and that the extent to which a technical man was aware of these areas of learning he would be better equipped to contribute usefully to society and the progress of civilization. An engineer properly versed in the principles of science could provide the more ably for the needs and comforts by taking into account in the practical world the effects of these principles from the
At about this time (1860) the controversy between the Scientific Universities and the Technische Hochshulen in Germany was coming into full flower. The Scientific Universities, which were dedicated to the cause of scientific investigation were not in a position to communicate scientific knowledge to craftsmen and engineers. What is more, they were generally unwilling to put themselves in this position. On the other hand, the Technische Hochshulen, which desired to teach engineering subjects from a scientific point of view were hampered in this aim due to a lack of facilities for teaching science and of personnel with thorough scientific training. This separation of the two types of training always implied an undesirable time lag in the transference of new scientific thought to the technical consciousness. By combining these two strands of educational method, Professor Rogers desired to have a close and continual interaction between science and engineering in his School. He desired to capture the best elements of both strands, while eliminating the difficulties of having them separate.

As a result, laboratory work became an important part of technical education. It is significant in this regard, that Rogers established at M.I.T. the first laboratory of physics, the facilities of which were available to the entire School. Finally, recognizing the importance of Letters in a well-rounded education, Rogers provided for the teaching of English, Modern Languages, and those disciplines of Philosophy which would enhance the student's powers of thought and concentration. The classics and classical languages were considered out of place in the proposed school, and therefore excluded.

Rogers felt, moreover, that the development of an adequate technical and scientific education could not be left to the existing
colleges and universities, which were set up to teach the classics after the fashion of the Medieval universities. They were resistant to change. They scorned the experimental method of scientific investigation and the laboratory method of instruction. Their requirements for a bachelor's degree were too strict to allow for the highly specialized training needed by a student whose vocation was in industrial science and engineering. The difficulties incurred by the Lawrence Scientific School at Harvard and the Sheffield Scientific School at Yale were testimony to this fact. These schools found themselves constantly encumbered by required courses of their respective Universities - courses which would be of no use to a man upon graduation. What is more, these schools were at the mercy of their universities for the disbursement of funds which were so badly needed for equipment and expansion. The proposed Institute would remain free from all encumbering alliances with other educational Institutions. It would have to find its own sources of funds, but it would be able to use them as it saw fit.

This does not mean that schools of engineering were to be irrevocably at odds with schools which taught the classics and classical methods. Rather, it means that the specific aims of the two types of schools were not closely related. Each had its purposes, and the purposes of both were valid, but it would be best for the cause of a technological education if the two remained separate, at least for that time.

Professor Rogers stated,

"It will...be seen from the peculiar character and object of this departure of the Institute (the School of Industrial Science) that it could not interfere with the interest of the established schools of learning devoted to general literary and scientific education. Aiming to supply the industrial classes with a knowledge and training of which they are
specially in need, and which it would be incompatible with the purpose and organization of the universities and colleges to attempt to provide, it would, we feel assured, command the good wishes and active sympathies of the scholars and men of science who dispense the high instruction of these schools."

Henceforth, the proposed Institute would be considered an integral part of the Conservatory of Arts and Sciences. In the course of the coming year, the Society of Natural History and the Institute of Technology would receive grants of land on the Back Bay. A few years later the Horticultural Society and the newly formed Museum of Fine Arts would receive grants of the Back Bay lands as well. Thus, except for the fact that only two of the grants were adjacent the purposes of the Conservatory were fulfilled.
FOOTNOTES

1. Life and Letters of William Barton Rogers, Vol. II; also annual message of Gov. Banks to the General Court. 659.

2. See Cross Papers.


4. Professor Rogers and his brother, Henry, did the original work on the Geology of the Appalachian Mountains, and their paper presented before the American Society of Geologists in Boston in 1843 is regarded as the first great movement of American geology.
   Life and Letters of William Barton Rogers - Vol. I


6. Ibid., p. 31.

7. Rogers' support of the Conservatory was not dissociated from his interest in the School, because he had come to regard the efforts of both as necessary to the cultural advancement of Boston. We must remember here that Rogers had become intimate with those who were concerned with the cultural advancement of Boston, and had associated himself with the hopes and plans of those who were thus concerned.

8. Life and Letters of William Barton Rogers - Vol. II, p. 4. All sources indicate a meeting of the Committee on October 5, 1860, except a letter from Samuel Kneeland, Jr. to Professor Rogers, dated January 30, 1861, which states, "There was no meeting of the General Committee between May 28 and the 20th of October."

9. A newspaper clipping notes that this plan was submitted to a committee of the legislature at this time. --- Boston Advertiser, October, 1860.

10. Prof. Rogers thought it was. See Life and Letters of William Barton Rogers, Vol. I.
11. From "Objects and Plan" - see Cross Papers.

12. Message before a committee of the General Court in 1861, Life and Letters of William Barton Rogers - Vol. II, p. 271. See also manuscript-letter from Prof. Rogers to Prof. Youmans.
CHAPTER 4

PRELIMINARIES TO THE CHARTER

After being accepted by the General Committee of the Conservatory on October 5, 1860, the report of the plan was bound up in pamphlet form and distributed to all those in the city and the state who were most likely to be interested in such a project. The people who were sent the pamphlet were asked to unite with the Institute and to participate in the Society of Arts. The numerous responses over the next two months satisfied the Committee that the plan had hearty public approval. (By the autumn of 1860, Professor Rogers had become a respected cultural leader in the city of Boston. He had become thoroughly imbued with the cultural interests of the community and they in turn had taken up his hopes and aspirations for a Polytechnic School.)

In November, 1860, application was made to the General Court for an Act of Incorporation. In the same document the petitioners asked for a section of land to be reserved for the Institute, another for the Boston Society of Natural History, and a third for the Massachusetts Horticultural Society. The application contains a brief but significant description of the proposed Institute.

"The subscribers respectfully pray for an Act of Incorporation for an Institution to be entitled the MASSACHUSETTS INSTITUTE OF TECHNOLOGY, having for its object the advancement of the Mechanic Arts, Manufactures, Commerce, Agriculture, and the applied sciences generally, together with the promotion of the practical
education of the industrial classes, and proposing to attain these ends by the threefold agency of discussions and publications relating to industrial art and science; by a Museum of Technology, embracing the materials, implements and products of the practical arts and sciences; and by a School of Industrial Science, for instruction by lectures, laboratories, and other teachings, in these several departments."

It has been contended by a number of people that the purpose of M.I.T. originally was to train plumbers and carpenters and smiths to ply their crafts. In the light of the above statement of Rogers, this does not seem to be the case. If I might be allowed the liberty of a contemporary analogy, I would like to point out by analogy what manner of training Rogers had intended to give. Among the people who deal with the functioning of a television receiver are the "TV Repair Man" and also the engineers who designed the receiver. The "TV Repair Man" does repairs on a receiver essentially by examining the equipment for symptoms, and introducing a cure which may be found in a handbook. He need not know the physical laws concerned with what he is doing: just that certain operations will alleviate certain symptoms. He is essentially a maintenance man, and is in a position to do only minimal creative work. This is not the type of vocation for which Rogers had intended to train people. On the other hand, we have the engineers who designed and constructed the receiver. These men must be intimately familiar with Maxwell's Equations, the laws of structures, and many other laws, in order to be able to design a television receiver which will produce pictures at the will of the operator and be durable enough to remain in good operating condition for a long while under a wide range of conditions. These engineers must have a high degree of technical competence and a great deal of creativity. Rogers intended to train men who would
be engrossed with this spirit of technical creativity and competence.

However, in the year of 1860, there was not this great difference between a technician and an engineer. Professor Rogers doubtless had a difficult time explaining this difference in terms of the scientific and technical context of one hundred years ago. For, his successors and associates seem to have lost sight of this distinction at many points along the road of M.I.T.'s early history.

Neither was it Rogers' intention to train people who would concentrate on the pure sciences. He intended to produce neither a scientist nor a technician, but a person who would be at home in the areas of both of these, i.e., an engineer. He did not define exactly what an engineer should do or should be. In his statement of 1846, he gave what he thought an engineer should study in order to be prepared for his vocation. Also he set up courses and curricula designed to educate "engineers". But he did not give a precise definition of what an "engineer" is. This want of a short, precise definition of what an "engineer" is, and these imprecise practical definitions, have been the basis for a dialogue between science and the practical arts within engineering. His definition of the closely associated word, "technology" as the study of practical science and industrial arts also has contributed to this dialogue because it is similarly imprecise.

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On Monday, January 7, 1861, Prof. Rogers announced "a meeting in Mercantile Hall, 16 Summer Street, for Friday evening, 11th inst., at half past seven o'clock for the purpose of adopting measures preliminary to the organization of the Institute, and in furtherance of a petition to the Legislature for a charter and a portion of the Back Bay lands." Along with the poster announcing the meeting, he sent out a handbill which the recipient could sign
and return, thus enrolling himself on the list of prospective members of the proposed Institute. About two hundred of these were returned by the day of the meeting.

At this meeting a preliminary organization was set up, and the following "Act of Association", which Prof. Rogers endorsed as the "Original Act of Association of the Institute of Technology, January 11, 1861," was adopted,

"We, the subscribers, feeling a deep interest in promoting the Industrial Arts and Sciences as well as Practical Education, heartily approve the objects and plan of an Institute of Technology... as set forth in the Report of the Committee; and we hereby associate ourselves for the purpose of endeavoring to organize and establish in the city of Boston such an Institution, under the title of 'The Massachusetts Institute of Technology,' whenever we may be legally empowered and properly prepared to carry these objects into effect."

This association then resolved to designate a Committee of Twenty to conduct the business of the Institute until a permanent legal organization should be set up, and to obtain from the Legislature an Act of Incorporation. This Committee was instructed to draw up a Constitution and By-laws, to be adopted when the Institute should be legally so empowered. Prof. Rogers was appointed Chairman of this Committee. The Committee, thus formed, would approach the Legislature under the auspices of the parent organization of the Institute, the Committee of Associated Institutions of Science and Arts.

Armed with the public statements of his two hundred supporters, who were eminent men from all sections of Massachusetts, and letters of recommendation from numerous organizations, Prof. Rogers strode across the Common the next Monday (January 14, 1861) and submitted a Memorial to the General Court in the name of the Committee of Associated Institutions of Science.
and Arts. This Memorial requested a charter for the Massachusetts Institute of Technology, and that there be set aside from the Back Bay land a portion for the Society of Natural History, another for the Horticultural Society, and a third for the Institute. During the months of January, February and March, the proposed charter and land grant were the topics of debate in a number of legislative committee hearings, and Prof. Rogers was called upon to be the primary witness in behalf of the measure. As in the previous year, the friends of the School Fund opposed the granting of the charter on the grounds that the reservation of the Back Bay land would detract from the funds available to the deserving colleges and universities of the state.  

In his appearances before the committees of the General Court, Prof. Rogers was called upon to demonstrate that the proposed Institute would be unique in the state and that no department of any school was currently doing what he intended to do. He had to defend the notion that this plan would be of benefit to the industrial and business community of Massachusetts, as well as a "needed and truly momentous addition to our means of industrial as well as of educational prosperity." He was obliged to show that applications of scientific principles to the industrial arts would be worthwhile and fruitful, and that detailed instruction in these applications would also be worthwhile. On this point he stated convincingly, "The discoveries and the deductions of modern science have been so liberally imparted to the arts and have become so closely interwoven with them in every stage of their improvement, that to be an enlightened mechanic it is also necessary to a certain extent to be acquainted with science, nor is it less true that a knowledge (of the industrial arts) is requisite to a successful cultivation of science."  

Also, he was pressed to show that the engineer should be
worthy of the social status of a professional man. He stated,

"Thus trained in the details of the sciences as well as the practice of the useful arts, the mechanic would be placed on a level in the point of professional education with the lawyer and the physician. He would be but little likely to feel humiliated by a comparison of his accurate and substantial attainments with the more general requirements of our higher institutions of learning. Thus thoroughly prepared for the practical usefulness in his profession he would command that station in society to which the high value of his exertions give him so just a claim." 3

In addition Prof. Rogers collided once again with those who were concerned about inroads upon the School Fund. He was never able to convince the General Court that a reservation of the Back Bay lands for the Institute would not constitute a misappropriation of the School Fund money. To meet the objection of the friends of the School Fund a very unusual amendment was made to the Act as finally passed, by which it was provided that "the lots fronting on said square on Boyston, Clarendon, and Newbury streets shall be reserved from sale" until the Institute and the Natural History Society shall be enclosure and improvements put said square in a sightly and attractive condition." The square and the lots fronting on it, as specified, were to be appraised upon the passage of the Act; and if "when the lots fronting on the square shall have been sold and the proceeds of such sales shall not be equal to the whole amount of the appraisal above mentioned, then the Societies named in this Act shall pay the amount of such deficit into the Treasury of the Commonwealth for the School Fund, in proportion to the area of the land granted them, respectively." 4

After the passage of the Act, Prof. Rogers called this explosive rider an "ungratious condition." It was repealed in 1863, but the entire grant might have failed in 1861 without it. 5

On March 19, 1861, the Joint Standing Committee of the
House and Senate on Education presented their Report on the Memorial of the Associated Institutions, which had been submitted the previous January 14. Favoring Prof. Rogers' plan, the Committee asked him to write their report, which recommended the granting of the Charter and the reservations of land for the three organizations, the Institute, the Society of Natural History, and the Horticultural Society. The Act of Incorporation was subsequently passed by the General Court, with two riders. One was that mentioned above. The other was that the Institute should raise a fund of $100,000 over the period of the year following the date of enactment. The Act was signed by Governor John A. Andrew on April 10, 1861.  

Now that the Institute had its charter, two tasks awaited Prof. Rogers; the first -- obtaining the $100,000 fund, and second -- describing in minute detail the educational policies of the Institute.
1. He had found out in the last legislative session that public endorsement sometimes spoke more forcefully to legislators than good oratory, and arguments of reasonability and desirability.

2. In view of the announced purposes of the Institute, this was a supremely narrow-minded objection, and to some extent self-negating.

3. Message to a committee of the General Court in 1861.


6. No grant of land was given to the Horticultural Society through this act.

7. The fall of Fort Sumter and the outbreak of the Civil War on the following Friday, April 12, 1861, threw an immense number and variety of severe financial complications into the life of the newborn Institute. The time was extremely unfortunate for the launching of this enterprise in education. However, with an extension of one year from the legislature, the fund was gathered.
CHAPTER 5

IMPORTANT EDUCATIONAL POLICIES
OF THE NEW-FORMED INSTITUTE

After the tenth of April, 1861, the Institute was a reality. It was no longer the dream of an idealistic thinker. Eight years of careful planning by Professor Rogers and his friends had seen it through to incorporation. Before it lay yet many years of difficult planning and organizing. At this point, Rogers' conception of an Institute of Technology takes on a new dimension, the dimension of a functioning organization. When we talk of Rogers' conception of an Institute of Technology now, we are constrained to consider a functioning organization as it is related to that conception.

The functions of the Society of Arts were instituted almost immediately. That body would not cease from its original intended purpose (as stated above) until several years after the death of Professor Rogers. In the course of its not very long and not very illustrious career, the Society sponsored lectures by famous scientists and inventors, and also passed judgments on the merits of diverse manufacturing techniques, etc. The Museum of Arts was never formally organized.

Over the years the School of Industrial Science was to become the essential and abiding feature of the Institute. Not long after the death of Professor Rogers, the School of Industrial Science was all
that remained functioning of the Massachusetts Institute of Technology. Indeed, the School of Industrial Science became the whole of M.I.T.

On May 30, 1864, after numerous delays, Professor Rogers, who was now President of the Institute, proposed to the annual meeting of the Corporation, "...it is especially desirable to commence the systematic professional courses of the school,..." Whereupon, he presented for the approval of the Corporation a document entitled, "Scope and Plan of the School of Industrial Science of the Massachusetts Institute of Technology". This document was a very detailed statement of the educational policies for the School of Industrial Science about to be formed, and as such will be studied in this chapter. In addition, we shall examine Prof. Rogers' comparison of the Technische Hochshule at Carlsruhe with his own hopes and plans for the Institute, as well as his concerns about affiliation with Harvard. These three interrelated problems were his main concerns for the Institute, and they shall be the topics of consideration in this chapter.

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According to the Scope and Plan,...

"It is the design of this School to afford to the public at large opportunities of instruction in the leading principles of science, as applied to the Arts; and at the same time to provide for systematic students of the applied sciences the means of a continuous and thorough training in the studies and practice appertaining to these subjects. In pursuing this object, it is intended to give to the teachings such scope and method, that while imparting a due measure of knowledge, and cultivating the habits of observation and exact thought so conducive to the progress and development of an enlightened industry that may help to extend more widely the elevatory influences of a generous scientific culture."
The School was subdivided into two departments. The first was a **General** or **Popular Course**, which was open to the public. Classes were mostly at night or after business hours and were presented as an extended series of lectures. The second department gave specialized and professional instruction. Classes were held during the day, and students were expected to attend on a full-time basis. A smaller tuition fee was proposed for the first department than for the second.

The General Course gave basic lecture courses in various fields of science (i.e., Mathematics, Physics, Chemistry, Geology and Mining, Botany, and Zoology). These lecture courses were intended to meet the general public needs for scientific knowledge and to prepare students for a more thorough training. They were intended to teach with accuracy and completeness in order to give a clear understanding of scientific principles and their applications to the useful arts. Recent discoveries and inventions would be discussed in order to disseminate to the public an early insight concerning their importance. The lecture courses would be open to both sexes, and the only requirement for admission was an interest in scientific matters. Since the goals of this department were the espoused aims of the Lowell Institute, Mr. J.A. Lowell, the Trustee of the Lowell Institute, and now a Vice-President of the Massachusetts Institute of Technology, proposed to Professor Rogers that the Lowell Institute present such courses on the premises of the Institute with the assistance of some of their professors. This was the beginning of the formal association between the two Institutes, which continues to this day. Thus, the Lowell Institute filled the area of the first department.

The second department of the School was intended for two types of students, "first - for such students as by a full course of
scientific studies and practical exercises seek to qualify themselves for the professions of the ... Engineer, (and) second - for those who aim simply to secure a training in some one or more of the applied sciences." Five courses of specialized instruction were announced: (1) Mechanical Engineering, (2) Civil and Topographical Engineering, (3) Building and Architecture, (4) Chemistry, (5) Geology and Mining. The studies of each class were arranged to extend over a period of four years. For the first two years the studies and exercises were planned to be the same for all regular professional students, so that each would have a good acquaintance with the whole field of practical science, and would be able to call upon this knowledge in his professional studies of the third and fourth years. However, if students were prepared to enter an advanced course, they were allowed to omit the required basic courses, while still receiving credit for them. Taking this condition into account, a student might pass through his entire course of instruction in three years or less.

In order to gain admission to the school, a student in the first year had to be at least fifteen years old, and one in the second year had to be at least sixteen. Also, he had to pass an entrance examination, or give other acceptable evidence of his qualification. In order to pass on to the second year's studies, the first year student had to pass examinations on his first year's work.

The instruction in this department of the School would be given,

"through the medium of (1) lectures, (2) examinations, (3) exercises in the solution of presented problems, (4) practice in physical and chemical manipulations, (5) laboratory training in chemical analysis and metallurgy, (6) drawing and the construction of specific plans and projects of machines and books of engineering and architecture, (7) practical exercises in land survey,
tending, geodesy, and nautical astronomy, and (8) excursions for the inspection and study of machinery, motors, processes of manufacture, buildings, books of engineering, geological sections, quarries and mines."

Each lecture was to be accompanied by an oral exam, where the instructor would briefly take the opportunity to stress the important points of the previous lecture. The students (excepting first year students) were expected to take lecture notes, and to organize them so that they would be a suitable study reference and supplementary reference for the course. Ordinarily no rote memorizing would be relied upon. Until the student was accustomed to the work, he could call upon his instructors for assistance in editing and correcting his class notes.

At the end of each half-year, in February and in June, the students were to pass through a period of final examinations. At these times the courses of instruction would cease and a period would be set apart to allow the students a brief time for review. Also, Professor Rogers recommended that thorough written exams be given frequently during the semester because this was the

"best means of inciting the students to diligence in their studies as well as of testing their progress and of finding out those individual needs and difficulties which the teacher should endeavor to obviate."

Before graduation, each student was expected to pass through a period of examination covering the entire scope of his course of study. Also, he was required to submit a thesis and defend it in public if his instructors saw fit. By the time that a man had completed his four years at M.I.T., he was well versed in the methods of experimental science. His education was thoroughly practical, but in terms of scientific competence, he was a worthy peer to the graduate of any other scientific college or university in the world.
According to Professor Rogers the Diploma of the Institute

"is intended not only to be a reward to the student for his diligence and attainment, but an assurance to the public of his knowledge and skill in the particular department of applied science to which it relates. It will be conferred only on such students as by their examinations and other exercises give proof that they possess the prescribed qualifications."  

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In the summer of 1864, Professor Rogers travelled to England and Europe for the purpose of visiting some of the technical institutions there. There is only one account of his impressions of that visit. It is from the Boston Journal of December, 1864, and is a report of a meeting of the Society of Arts, at which he spoke.

The result of his observations has been the conclusion that

"we in this country have a great deal to learn in the arrangement of museums of practical art and science, and much also to learn in regard to the auxiliaries of practical art education. Yet our educational system is in many particulars abreast of the Old World schools, and in the elementary principles decidedly in advance of them. Looking to scientific education and methods of instruction, there is such vitality, quickness of observation and ready, flexible application belonging to our countrymen, that we have already embraced some of the most important ideas introduced in Europe. What is wanted is for American students to give time enough to secure thoroughness in the study of applied sciences."

Apparently, Professor Rogers found a great lack of flexibility, which he considered essential, in the teaching methods of the European schools. However, he was favorably impressed with the heavy emphasis laid upon a broad scientific background.

The Journal continued,

"The Polytechnic Institute at Carlsruhe, which is regarded as the model school of Germany and perhaps of Europe, is
nearer what is intended the Massachusetts Institute of Technology shall be than any other foreign institution. It has an extensive museum of models of all conceivable mechanical combination, which are the objects of study by the pupils. ... There are also series of laboratories adapted to the different branches of chemistry. Every part of the establishment is designed for use and not show...."

Other than this visit of 1864, it does not seem that Rogers had but the barest of contact with the Hochshule at Carlsruhe or with any other such school in Germany. Although this great Polytechnic School comes very close to Rogers' conceptions of his emerging Institute, it does not seem to have had the full measure of interplay between science and the industrial arts, which he had intended for his school. Also, it must be remembered that his ideas had already been extensively formulated and recorded before this visit took place, and he was probably not greatly influenced by what he saw. Even though Prof. Rogers' work was the result of original thought on his part, it must be admitted that the School of Industrial Science at M.I.T. was very similar to the Hochshule at Carlsruhe in structure as well as purpose. That he was impressed with what he saw at Carlsruhe cannot be denied.

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In his annual message to the General Court on January 9, 1863, Governor John Andrew recommended that all of the institutions of higher learning in Massachusetts, including M.I.T., should be fused into a state-wide university centered in Harvard University. As Professor Rogers pointed out to Dr. William J. Walker on May 4, 1863, the Institute had determined from the beginning to stand alone. Its independence was essential to its success, and it would accept no grant from any quarter which would interfere with its independence in the slightest way. He pointed out to Professor
Youmans in 1867 that this was not due to an inimical attitude on his part to the methods of classical education, but rather due to the fact that those methods were not broad enough in scope to give the liberality in program needed by the Institute. Furthermore, "this training (classical training) can in no degree replace the investigating exercise of the observing and logical facilities so peculiarly the function of scientific studies." In a letter to the government of the Institute, Professor Rogers acknowledges that the prospering of the Institute was due in a large measure to its separate individuality and freedom from the binding traditions and precedents of the older institutions.

In 1870 due to reason of ill health, Professor Rogers found it necessary to resign the Presidency of the Institute. Almost immediately thereafter, Charles W. Eliot, President of Harvard, and late a Professor of Chemistry at M.I.T., saw the need to bolster the slumping position of his Lawrence Scientific School. His proposed remedy was to annex the Institute to the Lawrence School. Although Professor Rogers had no longer any official position with the Institute, his stinging rejection of the proposed merger was the deciding factor against it. He stated that if the Institute relinquished its self-government, it would relinquish its freedom of development, thereby sacrificing the most vital element of usefulness and prosperity. Also, it would sacrifice a reputation as a leader and reformer in American education, and its educational facilities would not be made any more accessible to anyone if the merger took place. Although many argued that a scientific department and a classical department side by side would be a source of great stimulation to both departments, Rogers stated that one would have the dominating influence over the other - in the case of Harvard,
the classics over the sciences. Finally, the future of the Institute and along with it the future of scientific education in America should not be drastically altered merely because of an offer of increased resources.
FOOTNOTES

1. The Society of Arts was probably not as successful as Rogers had hoped it would be because for the most part, it did not have in its membership men who were mentally keen enough to communicate intellectual stimulation among themselves. Reading the records of the Society, the present writer gets the very distinct impression that Rogers' dynamic intellect and winning personality were its mainstay. After he was gone there was no one to carry on in his place. Consequently the Society dissolved.

2. See Cross Papers.

3. Two footnotes must be added to this section:
   I. The Russian system of shop work introduced at M. I. T. by President Runkle in 1876 was nothing more than a system of practical exercises in manual training. It constituted no improvement to the facilities of the Institute and was soon discontinued.

   II. The School of Industrial Science was in a position to do experimental work for the Society of Arts at their request, and to report to the Society upon this work. However, the true beginning of experimental work at M. I. T. is perhaps to be found in a letter from Professor Rogers to Professor R. H. Richards, dated July 24, 1879. In this letter he describes the rules of a policy for subsidizing scientific work at the Institute as follows:

   (1) The privilege of using the equipment of the Institute is to be given only to scientific experts and approved students, preferably graduate students whose aim is the advancement of science.

   (2) The experimenter shall state his objects, and name the equipment he will need, as well as when he will need it.

   (3) The experimenter is expected to handle the equipment with scrupulous care and to return it in as good condition as when he found it.

   (4) The experimenter is expected to replace or pay for all equipment and supplies used up or destroyed.

   (5) The experimenter is expected to place a record of his results with the archives of the Institute and give credit to the Institute for their facilities used in his work if he publishes the results.
4. It should be noted though that Professor Rogers founded the first laboratory of Physics available for general institutional training and use (William Barton Rogers' letter to government of Institute - 1870). Also, it is a tribute to Rogers' planning and guidance that, after a scant five years' operation, the Institute could claim the leading place among American scientific schools.

5. Dated December 27, 1869.

6. In a letter to R. C. Greenleaf dated July 26, 1870.

7. A huge grant, the proceeds of the Bussey estate, was the primary bait offered by Harvard to the debt-ridden Institute.
CHAPTER 6

CONCLUSION

As we have observed, technical education was an outgrowth of the Scientific and Industrial Revolutions. As discoveries in science became known to the public at large, intelligent, practical men saw that they might be applied to practical situations in order to make life a little more easy and pleasant. In time the body of scientific and associated practical knowledge became so large that the service of men trained in these things was in great demand. At this time, which was the latter third of the eighteenth century, there began to spring up schools whose main purpose was to train men in this new knowledge. For years the controversy raged concerning how this type of training should be presented and what subject matter should be included, until William Barton Rogers gave his answers in the middle years of the nineteenth century.

As founder of M.I.T., Prof. Rogers left the School a legacy of industrious and fruitful labor, coupled with keen, penetrating insight. The immediate reasons for the remarkable success of the Institute are two-fold: the personal diligence of Professor Rogers, and his insights. But, in truth he left this legacy not only to M.I.T., but to the whole of the rapidly developing technology.

From the very beginning of his life, William Barton Rogers was trained in the way of foresight. He had learned to take careful account of the needs of the present when planning for the future. He
was trained to persevere even when the hopes of success became dim. His keen mind was trained to take account of broad categories of life's spectrum and to treat them with the depth of a thorough understanding. All of these facets were necessities when he came to the task of founding M.I.T. He strove for long years to win the confidence of the people of Boston, and thereupon to surround himself with intelligent and capable men who had become dedicated to his ideals. With the entire country eclipsed by civil war, he struggled on through many dark hours to the completion of the Institute. He expended apparently boundless energies on behalf of the Institute. His carefully laid plans for the future Institute were impressive in style yet realistic and never in need of amendment.  

His two great insights in behalf of the Institute were -- first, the need for interplay between science and the practical arts in technical education, and -- second, the Institute's need for independence from other educational institutions. This first insight can be called his great insight on behalf of engineering. It was the spirit of this insight which fostered the great growth in technology over the past century. After its first formulation in 1846, this insight never left him. At the graduation exercises of the class of 1881, he observed,

"In art truth is the means toward an end; in science truth is the end; and yet, though there seems to be a distinction between them, we find there can be no distinction made. Every thread of art is entwined with the fibres of science. Art begins; science continues. In the whole history of human knowledge we find that science begins on simple art as its foundation, and art is extended by the investigations of science, and so on in alternate succession till the whole body of knowledge has been accomplished. Hence a school of science like ours must comprehend a large amount of practical work, as well as a large body of scientific study. The scientific man
is one who is trained; he is the practical man of the
world...In order to be truly practical we must know
the material with which we work, the implements which
we use, the character and properties and forces of those
materials, and the mechanical qualities and properties
of them, too, and in knowing this we must be scientific.
We maintain that in the school in which we are here
interested we are training men in a preeminent degree
not only to be scientific, but to be practical, and to be
practical because they are scientific."  

His second insight - for the independence of the Institute -
was as necessary as his first insight, because it allowed technology
the free atmosphere of development which was so necessary for its
growth. When Rogers began his great work in 1860, technology
and practical science were looked down upon by the great univers-
sities. Technical schools were not considered worthy of the same
high position which the universities themselves held. Had not Rogers
struck an independent course for M.I.T., it is very likely that the
growth of technology and the development of technical education and
technology would have been slowed considerably.

By the time of his death in 1882, Rogers had set the policies
which would culminate in the vindication of technology as a field of
professional endeavor. His former students, as engineers, were
becoming accepted as ranking among the numbers of leading pro-
fessional and educated men, and his Institute was soon to be con-
sidered among the very best technical and scientific institutions
in the world.
FOOTNOTES

1. Apparently Rogers never changed his mind on anything unless necessitated by a change in circumstances. He had the ability to be right the first time and to account for a multitude of possibilities.

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