temperatures so essential in metallurgical and other industrial processes; also the conditions under which metals are deposited electrolytically. Out of these great industries have sprung up as if by magic.

The cryogenic field is one in which both physics and chemistry are brought to bear in the production of low temperatures, the liquefaction of gases, the production of gases essential in both science and industry. The striking laboratory experiments of a decade or two ago were the forerunners of great industries of to-day.

In the field of metallurgy, applications of physics and chemistry form one of the newest and most important branches of science and its applications. The metallurgist juggles with metals and produces mixtures at will with almost any given properties, without which many modern industrial developments would have been impossible.

This is true to an amazing extent of all the materials we use, the bricks with which we build the refractories that line the furnaces of industry, the finest porcelain, the cement, the glass and all the materials of construction.

The fuel question is the most important of the automotive industry. The clothes we wear and the papers we read involve the use of scores of materials. In connection with the use and production of all these materials, new fields of technology have arisen based upon physics and chemistry of the most fundamental nature.

It is becoming difficult to classify science as pure and applied. Engineering and technology involve the most difficult problems in the fields of pure science. Industries are calling for and producing the most fundamental scientific data. Hence, in the training of men we must not overlook the intent of the founders of the institute as to the relations between the basic sciences and technology even though each has advanced far beyond their most sanguine vision.

To maintain the ideals of the founders and the best traditions of the institute, they must be interpreted in the light of modern science and the problems of the day. All its functions must be carried on in an atmosphere of research, if it is to be a blazer of trails to new fields and not merely the follower of beaten paths.

Recognizing these facts, the corporation has adopted a plan of organization which will permit of the administration of the affairs of the institute in accordance with the requirements of the present, and the conditions under which it can perform its functions most efficiently. This new plan provides for both a chairman of the corporation and a president of the institute; heretofore the latter has served in both capacities. In the present case the retiring president becomes chairman of the corporation, who at this time wishes to express his great appreciation of the support given him as president and the hope that these friendly, helpful relations will continue while he is its chairman.

Alumni and Friends of the Massachusetts Institute of Technology:

I have the honor of presenting to you the choice of the corporation for the next president of the Massachusetts Institute of Technology—Professor Karl Taylor Compton, chairman of the department of physics at Princeton University—eminent investigator in the field of physics, with a long list of original contributions to knowledge in this branch of science to his credit.

Honored by degrees from many institutions for his brilliant work in science.

Member of the National Academy of Sciences and an active leader in the organized bodies of American scientists.

Sympathetic with the applications of science in the fields of engineering and industry.

Who rendered most important scientific service during the late war.

And above all, a man who is universally loved and admired by all who know him.

To you, President Compton, I commend a corporation composed of successful men actively interested in the affairs of the institute. As its leader I foresee a constructive cooperation with you:

A loyal faculty, appreciative of your leadership,

A serious energetic, self-governed student body, which will be your greatest inspiration.

## INAUGURAL ADDRESS

### By Dr. KARL T. COMPTON

PERMIT me to take this opportunity briefly to discuss certain features of the Massachusetts Institute of Technology which have induced me, with real enthusiasm, to cast my lot with you as a part of this new organization. I venture to hope that this is appropriate because the significance of these considerations is not primarily to me personally, but to every one who is interested in science, and in the contributions which science has made and will in the future make to the happiness and welfare of mankind.

The three most pertinent questions in evaluating any institution would seem to be, "What is its pur-

pose?" "What is its accomplishment?" "What is its future?" It is through its answers to these three questions that the Massachusetts Institute of Technology commands allegiance and support.

I venture to formulate the purpose of the institute as "the development of science and its useful applications," and to describe the method of accomplishment of this purpose as being "through continual study and research combined with the training of men." This purpose is dictated by the opportunities found in modern science for contributing in such a fundamental way to the necessities of life that it is not surprising that the distinguished founder of this institute, William Barton Rogers, expressed it and recommended the means to accomplish it in words which are every bit as significant to-day as they were when he wrote from Virginia in 1846 to his brother Henry in Boston, outlining his plan for an institute of technology. This was fifteen years before the institute was incorporated and nineteen years before it was actually opened. He says:

> The true and only practicable object of a polytechnic school is, as I conceive, the teaching, not of the minute details and manipulations of the arts, which can be done only in the workshop, but the inculcation of those scientific principles which form the basis and explanation of them; and along with this a full and methodical review of all their leading processes and operations in connection with physical laws.

Dr. Rogers then goes on to outline an organization and a curriculum which are astonishingly like those of to-day, which have stood the test of time and experience. As an example of constructive imagination, good judgment and prophetic vision, I wonder whether there is an equal to this in educational literature!

Turning now to the question, "What has been the institute's accomplishment?" I almost hesitate to attempt an answer, because its direct and indirect influence have been so enormous. As the first category of accomplishment I would mention its alumni. They comprise builders of huge industries, organizers and executives of great companies, leaders in science, engineering and architecture, and a great host of men who are ably engaged in operating and developing the vast industrial system which is the distinguishing feature of our present civilization. And in educational work they have taken an equally prominent part. For example, I recently visited a great Mid-western university in which I found that all four of the deans were Technology men. During the past few months, since I have become so particularly interested in the institute, I have been continually amazed to discover how important a rôle its alumni are playing in the life of the country. There can be no doubt regarding the value and vigor of an institute which has trained such men.

As the second category of accomplishment I would point to the other great technological and engineering schools now scattered all over this country, which are the direct offspring, so to speak, of the Massachusetts Institute of Technology and patterned after the original plan of President Rogers, each with an individuality born of local conditions or of desire particularly to emphasize one or another aspect of the general plan. In thus providing a pattern and also to a very large extent the faculties for these newer technological schools, the institute is in the position of the founder of a sturdy and illustrious family. And this is true not only in this country but also abroad. It is held, for example, that the tremendous technical and industrial development of Germany is due largely to the fact that that country, perhaps more than any other, was quick to grasp the value of President Rogers' ideas and, with characteristic efficiency, to build upon them a nationwide system of technical schools and of industrial development.

As the third category of accomplishment, I would like to suggest simply the present industrial and economic structure of the country. Of course very many factors have entered into this, and the part which the institute directly or indirectly has played is rather undefined but none the less real and of tremendous significance. Time does not permit elaboration of this interesting theme.

And finally, "What of the future?" From past experience and accomplishment we may gain wisdom, guidance and encouragement, but it is the future which vitally interests us. In regard to this future there seem to me to be several outstanding considerations.

In the first place there appears to be no reason for any change in the purposes and ideals of the institute. As I have already remarked, the institute has been devoted in the most fundamental way to the benefit of mankind through science. There is every indication that only a beginning has thus far been made in the science of discovering and understanding nature and in the art of usefully applying this knowledge. I can conceive, therefore, of no more appropriate or urgent program for the institute than simply to continue its work of developing both principles and men for applying science to problems of human welfare. But, although the purpose of the institute is unaltered, I do believe that present conditions indicate the necessity of careful attention to several vital matters.

First I would suggest the necessity of greater emphasis upon the fundamental sciences both in their

own rights and as the bases of the various branches of engineering. As engineering has developed to greater and greater complexities, it becomes increasingly impossible to hope to train men in those exact processes of thought or manipulation for which they will later be called upon. And as scientific discoveries and applications are ever increasing at an accelerated rate, there is ever-increasing probability of meeting problems far off the beaten trail. Also many who start in as engineers later become executives or administrators. In all such situations a broad and thorough training in fundamental principles gives much greater power than a training in details which may seldom be encountered in practice. Again, whereas a generation ago most of our great technical industries were in their infancy and needed many men trained in the details of their respective arts, now most of these industries are large organizations which are equipped and prefer to train their own men in the fine points of their art: they absolutely require, however, men who come with a sound basis of training in fundamental principles. The institution which supplies these men supplies the men destined to leadership.

Every application of science presupposes a discovery of science to be applied, so that the useful applications of science are in the last analysis limited by the extent to which scientific research has been successful in uncovering the hidden forces of nature. Then, when these scientific discoveries are put to the service of man, there is always a limit to the available extent of this service—a limit set by some such thing as a defect of material, inability to solve an equation, or some disturbing factor. So here again it is the province of research to push back or remove these limitations. While, therefore, in its humble beginnings, the greatest service of an institute of technology might very well have been to acquaint men with the laws of science and the technique of their application, an institute of technology to-day, to perform its greatest service, must take the lead in actually developing science and its applications as well as in technological instruction. In fact no proper or adequate teaching in these days can be done except as it is permeated with the spirit of research, for every constructive activity of life which is not mere routine consists of the continual endeavor to solve problems, in which broad training in fundamental principles and the inculcation of the true spirit of research constitute the best possible preparation.

I hope, therefore, that increasing attention in the institute may be given to the fundamental sciences; that they may achieve as never before the spirit and results of research; that all courses of instruction may be examined carefully to see where training in details has been unduly emphasized at the expense of the more powerful training in all-embracing fundamental principles. Without any change of purpose or any radical change in operation, I feel that significant progress can thus be made.

Second let me emphasize the supreme necessity of maintaining a faculty of absolutely first-grade men, despite the increasing difficulty of doing so. Here, as in every organization, the question of personnel is the supreme issue. But, unlike other organizations, an educational institution can make a perfectly logical and unanswerable argument that its need of the best men should supersede the claims of any other organization. For it is these men in the educational institutions who train and inspire all the others; their abilities are renewed and made available to the world in every graduating class. The folly of sending our youth to second-rate teachers in the hope of obtaining a first-class training is too absurd to discuss. And yet this is a very real danger, for industry is competing with universities for the best men, often taking them and then perhaps later finding fault with the institution for not giving its students a first-class training! I could go on at great length on this topic, which is one so easy to argue, yet so difficult practically to solve.

Several things, I believe, conspire to make this situation so serious. Industry can outbid an educational institution for a man if it wishes to do so. An industry may be short-sighted, looking only to its profits for the next few years. Or it may realize the situation and, if left to itself, would not try to take a certain man from an educational institution—but realizing that if it does not some competing concern will, it proceeds to invite the man to join its staff. There are instances in this institute in which an industry has taken man after man from key positions, leaving a department seriously embarrassed, crippled and criticized. (In fairness I should say, on the other side, that this demand for men by industry is stimulating and is really an evidence that the institute has been successful. It would, to my mind, be nothing short of a calamity if the demand by industry for men on the faculties were to cease.)

How, then, is this complicated situation to be handled? I doubt whether any rules, agreements or other artifices can hope to solve it. The solution must be found, I think, according to the regular economic laws, that is, by the institute's being in a position to offer to the man it needs a sufficient emolument in salary and advantages to hold him or, failing that, to secure another first-class man in his place. And the industries must, for their own ultimate self-interest, see to it that the institute is financially

able to retain on its staff the leaders in the various scientific and technical professions.

It has been well said that "civilization is measured by the ability to forego present pleasures for the sake of future benefits." In regard to the point which we have just been discussing, it is certain that only a few of our leading industries can be said on this basis to be civilized at all. Had it not been that many individuals have, by their generosity and vision, proved themselves "civilized" to a high degree, our technological institutions and the industries which have been so indebted to them would both now be in a pitiable state.

Just how industries can be brought to bear a fair share of the expense of giving first-class training to the men on whose discoveries and work they largely exist is a problem for the future. Certain it is, however, that its satisfactory solution would greatly accelerate the rate at which science and industry can contribute to the comforts and opportunities of life. In any case, however, the problem of personnel and financial means to maintain it at a high standard is one which presents a serious challenge.

The third problem of the future to which I should like to call attention is one which is not so fundamental as the two just discussed, but which is nevertheless very important and interesting. It is the problem of finding the most advantageous way in which the institute can cooperate with technical industries in the solving of their problems. As you know, a great step in this direction was taken with the inauguration of the so-called "Tech plan" and the formation of the division of industrial cooperation and research. Very valuable work has been done under this plan, but it has also had certain unsatisfactory features. I know from personal experience that contact of a university teacher with the practical problems of an industry can be professionally extremely stimulating and valuable. And certainly the institute should render every assistance in its power to any worthy cause within the range of its interests. The problem really consists in improving, if possible, the way in which this aid is rendered so that it may be not only as effective as possible in regard to the object of the assistance, but also done so as not to interfere with the other more fundamental activities of the institute—and if possible done so as to aid them. This problem is one requiring both study and wise counsel. Like every good problem, it presents opportunities as well as difficulties.

These problems which I have mentioned, and to which others might be added, are simply sign-posts pointing out the directions which our efforts must take in order to do our work most effectively. It is a work whose results will ultimately affect every man, woman and child and which should command the support of all except those few who are timid in the face of power or who for some reason fear to let man understand too much of nature. The Massachusetts Institute of Technology looks to us, who love and respect nature, to work out her future development. I join you in this work because I believe in its value, and for the same reason I feel confident of the cooperation of each of you, according to his position and opportunity. In its direct and indirect influence I can conceive of no more valuable service.

# OBITUARY

## ERNST CLEMENT ANGST

A CAREER which held every promise of distinction was terminated by the sudden death, on April 18, of Dr. Ernst Clement Angst, assistant professor of botany at the University of Oklahoma.

Dr. Angst was born in Chehalis, Washington, on February 15, 1899, of Swiss and Canadian parentage. He was educated at the University of Washington, receiving his doctorate there in 1929. He was married in 1923 to Carol Lavone Cramblitt, who survives him. From 1923 to 1927 he was a member of the faculty of the University of Idaho at Pocatello. He went to Oklahoma in 1929 and during his few months of service there won the undiluted respect and affection of his immediate colleagues and students.

In addition to published work on marine bacteria he was coauthor with Dr. H. H. Gran, of Oslo, of a monograph on the plankton diatoms of Puget Sound, now in press. At the time of his death he had collected, described and figured 145 species of Oklahoma diatoms nearly all of which were determined. This work will be completed for posthumous publication.

Dr. Angst was an unremitting investigator of the highest type, gifted with a facile and original technique and sound scientific judgment. In addition he was a splendid teacher whose lectures, erudite and methodical, were seasoned with quaint, incisive humor. His colleagues in the department considered it a privilege to listen in when they could, and it was not an unusual sight to see an entire class on the edges of its chairs. There is no question that a few more years would have seen Dr. Angst rated, not only as a great diatomist, but as a great teacher of botany.

PAUL B. SEARS
R. E. JEFFS
ADRIANCE S. FOSTER
R. H. MOORE