

# The Technology Review

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## STUDENT BLANKET TAX PRESENTED

Alumni Council hears the carefully prepared report of the undergraduate Committee and appoints a committee to report on it

The annual meeting of the Alumni Council was held at the Engineers Club, January 29. The salad orator was Professor Lewis who spoke of the work that is being done by Professor Noyes, '86, on the nitrogen supply for the United States government. President Hart was in the chair.

It was voted that, subject to the approval of the President of the Institute, the Executive Committee of the Council be allowed to appoint each year alumni committees to visit and report to the Executive Committee of the Alumni Association on the condition of the various departments of the Institute. Secretary Humphreys reported that it would be necessary to change the constitution in order to make a change in the requirements for representation on the Council of local associations. Inasmuch as some other changes have been considered it was decided to appoint a special committee to canvass the matter and to review both the constitution and the by-laws. The committee appointed consists of J. P. Munroe, '82; Everett Morss, '85; Frederic H. Fay, '93.

An informal ballot was taken for members of the nominating committee. The three men receiving the highest votes were A. Farwell Bemis, '93; Merton L. Emerson, '04; George B. Glidden, '93.

The annual reports from the various committees were received and will be found in the REVIEW for April.

John M. deBell, '17, president of the senior class, with four other undergraduates, E. P. Brooks, P. C. Leonard, L. L. McGrady, and R. W. VanKirk, were guests of the Council and have been invited to present the proposed blanket tax which has been discussed by the student body during the year. Mr. deBell made a splendid presentation of this matter which contemplates the financing of the undergraduate association. The student committee made a long and very thorough investigation and has come to the conclusion that an assessment of \$6.25 will adequately meet all the expenses of the association. The report in part is as follows:

In attacking this problem, your committee has chosen those items of expense which it believes should be borne equally by the students; these have been grouped and investigated under five separate heads, as indicated below. Your committee believes that the Undergraduate Association should pay—

A. The expenses of the Institute Committee, including (1) the office and incidental administration costs of the committee and its several sub-committees; (2) the cost of all Technology gatherings, such as CourTnyte.

Three hundred dollars a year would be sufficient to meet these requirements.

B. A definite amount to each class. It seems advisable that dues which have

hitherto been paid directly to the classes should be included in the Undergraduate Association dues, for these reasons: (1) All men should pay their class dues, for (a) only in this way are the financial burdens of the class fairly borne; (b) the classes in which the greatest percentages of members have paid their dues have done the most for the Institute; (c) 100 per cent payment of dues would mean heavier voting at elections, and consequently would ensure representative results through the Institute Committee; (2) this system of collection would be an improvement over the former one, for (a) it would eliminate the great time and energy waste of unsystematized effort; (b) the class would be sure of a definite adequate income and its board could spend its time in planning the most efficient distribution of the money; (c) the responsibility of financial administration would still be borne by the class governing board, while the Institute Committees check would be an added incentive to proper handling and accounting for the funds; (3) this system of collection with the Undergraduate Association dues would be most expedient, for it would make only one collection necessary, and this would be efficiently handled.

One thousand four hundred dollars a year would be sufficient for supporting the classes, based on the following division:

Freshmen.....	\$350
Sophomores.....	350
Juniors.....	280
Seniors.....	200
Permanent fund at graduation....	220
	<u>\$1,400</u>

C. The expenses of maintaining athletics. It is proposed to continue varsity athletics as they are at present, but to lay especial emphasis on providing agreeable exercise facilities for the large number of undergraduates who are not of varsity caliber. The latter plan would be accomplished by encouraging inter-class and intercourse competition.

Exercise is advisable for all students, to keep them in proper physical condition to meet the requirements of the Institute curriculum. The desirable con-

ditions are most likely to be fulfilled if all possible types of exercise are maintained, so that the student may choose that form which appeals to him, after finishing his first year's compulsory training. The capitalization of the facilities has already been largely handled by the Institute, but the maintenance should be borne by the Undergraduate Association.

Varsity athletics carried on moderately, as they are now, will (a) continue to advertise the Institute favorably; (b) provide incentive for the class and course contests.

Four thousand five hundred dollars a year, with receipts from Tech Show, would support athletics in a satisfactory manner.

D. A portion of the maintenance of the Walker Memorial. The maintenance of that part of the Walker Memorial not used for dining service or gymnasium should be borne by those for whom the building was provided. The total expense of this part has been estimated as follows:

Lighting and heating.....	\$1,920
Janitors, window washing, etc....	1,800
Attendants.....	1,280
Upkeep of games.....	900
Depreciation of inside fittings, not including games.....	1,800
	<u>\$7,750</u>

The income to meet this expense would be approximately:

Gross receipts from games.....	\$1,400
Cigar, candy, postoffice, net.....	600
350 associate members (instructing staff and alumni who would use the building) at \$5.....	1,750
Undergraduate Association.....	4,000
	<u>\$7,750</u>

This calls for Undergraduate Association expenditures of \$4,000, as compared with one of \$8,000 which was recommended to the Corporation of the Institute by the Alumni Walker Memorial Committee.

E. Health insurance—the provision of adequate medical attendance. Under this plan, a doctor would be in daily

attendance for free consultation and advice to the students. It has been deemed advisable to include health insurance in the proposed dues for the following reasons:

1. For the payment of a small sum, every student is assured free medical consultation and advice whenever he desires it. This will tend to cause men to consult the physician on slight provocation, thus greatly minimizing the danger of serious illness or epidemics.

2. Cases like the Field Day accidents will be treated free of charge to the individual.

3. Home treatment can be secured at rates much lower than the student could get independently.

4. The increasing number of cases of illness and accident, and the concentration of students in the dormitories, makes more adequate supervision of the health of the student more desirable.

The cost of maintaining such health insurance, exclusive of first aid facilities, which we believe should be furnished by the Institute would be one thousand dollars a year.

The summarized expenses are:

Institute Committee.....	\$300
Classes.....	1,400
Athletics.....	4,500
Walker Memorial.....	4,000
Health insurance.....	1,000
	<b>\$11,200</b>

With regard to the raising of this sum, two questions present themselves:

1. How should the money be raised? And, since it must almost certainly come from the student body,

2. How shall it be collected?

Your committee feels that the only equitable way of meeting the expense is to have it equally borne by all members of the Undergraduate Association; and it consequently recommends that annual dues of \$6.25 be paid by each member of the association. It further recommends that the Institute Committee petition the Corporation to collect the dues, as a part of the regular Institute expense, with tuition, dividing the sum between the first and second terms as

may be found advisable. With regard to first-aid provisions, the committee recommends that the Corporation be further petitioned to provide and equip a first-aid room. This could be done for about two hundred dollars.

In case the Institute Committee cares to consider the plan of this committee, it is felt that several pertinent facts should be pointed out, notably the advantages of the dues system to the Undergraduate Association, and its flexibility to meet the demands of increased membership.

The advantages to the Undergraduate Association are:

1. The system provides an equitable sharing of financial burdens, at a minimum cost to the individual.

2. It provides a convenient and efficient means of payment.

3. It eliminates possible control of any all-Technology function or activity by a private organization.

4. It increases the interest in undergraduate affairs of those students who are at present non-participating.

5. It provides for payment by the association of expenses which are justly its own.

6. It furnishes to each member of the association these specific privileges:

(a) Membership in the association, with the right to hold office in the Institute Committee or the activities which compose it; and the right to be heard in the Institute Committee.

(b) Suffrage rights in the classes.

(c) Free admission to Field Day and all athletic events held on Technology grounds.

(d) The right to use any of the athletic facilities supplied by the association.

(e) All privileges of the Walker Memorial.

(f) Free consultation with a physician, free treatment for accident or illness incurred in service for the Undergraduate Association, and other treatment at reduced rate.

The method of collection is deemed advisable because:

1. It is most convenient and efficient for all concerned.

2. Being advertised in the Institute bulletins, it will not appear to new men to be an extra, unexpected charge.

3. It will eliminate the necessity of expending great time and effort in educating the entire student body to the point where 100 per cent. of them will realize the necessity of such dues.

4. It has proved its value in institutions of higher education all over the country. Although your committee believes Technology is capable of independently meeting its problems, it nevertheless believes a thorough knowledge of conditions at contemporary institutions to be advisable, and has therefore compiled statistics of thirty-five colleges, with the following result.

In order to benefit by the experience of other American colleges along the line of a compulsory student tax for undergraduate activities, your committee has been in correspondence with some fifty colleges. These institutions have been chosen as representing the small, large, purely academic and purely scientific colleges of the country, and the data obtained we feel to be very representative of the status of taxation in American colleges. Replies are as follows:

Number of replies received.....	35
Number with tax compulsory by college authority.....	18
Number with tax compulsory by strong sentiment.....	6
Number with no tax.....	11
Average tax in eighteen colleges by compulsion.....	\$6.70
Average tax in six colleges by sentiment.....	10.15
Average tax in both.....	7.60
Average amount going to athletics..	6.10

In seven out of the twenty-four colleges the tax was for athletics alone. In nearly all of the eleven colleges having no tax it was stated that their receipts were more than enough to pay expenses, thus making unnecessary any athletic tax which seems to be the principal item in the other college taxes.

As income and expenditure would, practically throughout, vary directly as the student registration, it would be ad-

visable, in the absence of extraordinary circumstances, to increase the expenditures of the five groups in the same ratios. This would be equivalent to reducing the cost schedule to the following per capita basis, assuming a membership of 1,800 requires the above estimated funds:

Institute Committee.....	\$0.17
Classes.....	.78
Athletics.....	2.50
Walker Memorial.....	2.22
Health insurance.....	.56
	\$6.23

Your committee has collected the accompanying material, of which it will file a detailed report, should the Institute Committee desire to use the same in petitioning the Corporation. It also wishes to thank the Institute Committee for this opportunity to gather material which it believes will be of value to the Institute.

Very respectfully submitted,

THE COMMITTEE ON WAYS AND MEANS.

Edward P. Brooks, '17, *chairman*.

Paul C. Leonard, '17.

J. W. Doon, '17.

J. M. deBell, '17.

R. W. Van Kirk, '18.

L. L. McGrady, '17.

There was some little discussion on the conclusion of the report as to whether it was right and proper to create a tax that should be obligatory on all students as some of them have to make great sacrifices to pay for their tuition and the other necessary expenses. The students called attention to the fact that it is in reality the poorer students who are most punctilious about paying dues and the well-to-do who neglect to pay them. It was urged that this was a systematic and business-like way of providing for payment of the obligations of the students and would save an enormous amount of time now used in collecting dues. It was voted to refer the matter to a special committee of five members to report to the Council at the next meeting. The committee consisted of Henry J. Horn, '88; Jasper Whiting, '89; Henry A. Morss, '93; Russell White, '16; John M. deBell, '17.



## ANNUAL ALUMNI BANQUET

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Technology's duty to the National Government presented in its various phases

The annual dinner of the Alumni Association of the Institute was held at Hotel Somerset, January 6, 1917; the subject chosen for discussion was "Technology's Duty to the National Government," the subject being divided into two parts, "Technology and Research" and "Trained Minds for the Future Problems of the Nation."

President Charles A. Stone, '88, of the alumni association acted as toastmaster, and introduced as the first speaker, President R. C. Maclaurin, whose address follows:—

It is usual on such occasions for the President of the Institute to review the main events of the year that has just closed. The year of Mr. Stone's presidency will always be memorable in the history of the Institute, and the success of the various enterprises of that year have been due in large measure to the unstinted devotion of the alumni to their alma mater. These achievements have, however, stood out so clearly that it must be unnecessary for me to refer to them here. In what I have to say, therefore, I shall look, with your permission, rather to the future than to the past. There is, however, one matter of past history of which I should say something, as full information regarding it has not yet been given to the alumni. All who were present will remember the closing hours of the great reunion in June that was coincident with the dedication of our new buildings. On that occasion I announced the latest benefaction of Mr. "Smith" in the form of an offer to contribute five dollars towards a building fund for every three dollars that others would contribute towards the endowment of the Institute, his contribution being limited to two and one-half million dollars, and the time for securing the full benefit of his offer expiring on the first of January. The cam-

paign for securing the million and a half for endowment was, as you know, brilliantly begun by the generosity of a small group of alumni—the du Ponts, Mr. Stone and Mr. Webster, Mr. Adams and Mr. Hayden—who contributed a million dollars. The members of the Corporation took hold of the problem of raising the remaining half million. Of course the last half million always presents the greatest difficulties, but these were all successfully overcome and the whole amount of four million dollars has already been paid into the treasury of the Institute. You might be interested in a complete list of the contributors, but for the present I shall refer to only four. Two hundred and fifty thousand dollars came from Mr. John D. Rockefeller through the General Education Board, and \$100,000 from an anonymous benefactor in Boston (not Mr. "Smith") who has already made large contributions to the Institute. Especially gratifying was the establishment of an Endowment Fund of \$25,000 given to the Institute by the friends of the late Alexander S. Wheeler, long a member of the Institute Corporation. This fund is to be permanently associated with the name of Mr. Wheeler. Another specially gratifying contribution was that of \$15,000 for the establishment of a lectureship in business management, the lectureship being associated with the name of the late Frederic T. Towne, of the class of '94. This fund was supplied by Mr. Henry R. Towne, of the Yale & Towne Manufacturing Company, and by a classmate of Frederic Towne.

Now having received this million and a half dollars for endowment, what are we to do with it? There will be little difficulty as to that. Part of it will be required to take care of the cost of maintaining the buildings that are now occupied which are so much larger than our

old buildings. Unquestionably the next charge upon the fund must be the raising of the salaries of the instructing staff which, especially in these days of the high cost of living, are unquestionably far too low. When this condition has been even partially corrected there will be nothing left of the income from the special endowment fund that has just been raised.

If we were to pause for a moment to take stock of the Institute we should find it in an immeasurably sounder condition than ever before. It has a splendid and well-equipped plant on a magnificent site well adapted to present needs and for future expansion. Its endowment is much less inadequate than ever before, although in these days of extraordinary opportunities new advances involving enlarged expenditures are always in view. It is stronger than ever before in the esteem of the community and, what I think is of special importance, it is steadily improving its national and international position. Students come to it from every part of the Union, and the Institute has more than twice as large a percentage of foreign students as any other institution of university grade in the country. The great problem of the Institute as I see it is to make it even more distinctly national and there is surely no reason why two such institutions as Harvard and Technology in combination should not maintain the greatest school of applied science not only in the nation, but in the world. In line with the policy of nationalizing the institution, you may have observed in recent years that new members of the Corporation have constantly been selected whose interests are national in their scope. To mention only a few amongst the more recent additions to the Corporation: Mr. Theodore N. Vail, Mr. W. Cameron Forbes, Mr. Howard Elliott, Mr. Pierre S. du Pont, Mr. Frank A. Vanderlip and Mr. Otto H. Kahn. In this work of nationalizing the Institute the alumni must take an active part, and I commend this general problem to the consideration of your Council. It is clear, of course, that the only permanently effective

means of maintaining a national school is to train men in such a way that they can be of service anywhere within the nation. There is undoubtedly no part of the United States that does not urgently need and will not continue to need a large supply of men with a sound scientific training, and the demand for men so trained will unquestionably grow greatly in intensity in the near future. In this connection let me read to you an extract from a letter recently received by me from Mr. "Smith":

"When my first contribution to the M. I. T. was made, I had been carefully looking over the field for some time. I formed the opinion that there was no other place where a large sum of money could be invested with more effectiveness. That opinion has not since been changed in the least, in fact it was the growing strength of this conviction that led me to make my second subscription. I heartily congratulate the Corporation and you upon the broadmindedness and at the same time the conservatism with which the building plans have been carried out. I naturally feel great satisfaction in being instrumental in helping you to carry out such far-seeing plans for the development of the Institute, as I feel very strongly that the progress of this country is to be affected greatly by the men who are turned out of the M. I. T."

Time, of course, does not permit me even to touch upon the various ways in which the progress of this country will be affected by men who come under the influence of Technology. At present I can touch on only two phases of that great question. The first of these is the problem of research that has already been dealt with by one so well qualified to speak on the subject as Doctor Whitney, the director of the research laboratories of the General Electric Company. His position points the way to an inevitable development of the future. All over the country there must grow up in connection with almost every great industry large departments of research and one of the great problems of scientific education today is to prepare an adequate supply

of men who can fill the positions that will thus need to be filled. These departments of research will be absolutely indispensable to progress and even to existence in view of the competition with other nations that will inevitably follow the war. It is a mistake to suppose that these research laboratories will be filled with geniuses. A genius of the right type is, of course, a priceless possession, but there are never enough of these to go around and happily great advances can be made without them. What is particularly needed is a *large* supply, and I emphasize the word "large,"—a *large* supply of men with a sound knowledge of the fundamentals of science and trained to careful observation in the conduct of research. We must develop our vast series of laboratories at the Institute in such a way that every one of them not only gives promising men an opportunity for research but actually trains them in the business.

If I may use the language of the war, our progress during recent years has been made by a series of drives. We began by a successful drive on the Commonwealth of Massachusetts for a contribution that would enable us to attempt much larger operations. The next drive was a relatively short one to secure funds for a new site, then came the great drive extending over years to secure the erection and equipment of our buildings. The last six months has witnessed a drive for a four million dollar fund for special purposes. The great drive now must be for research, and here where, of course, we shall need money, we shall need much more than money—the earnest and careful consideration of the problem in all its phases and the active coöperation of all who are really interested in the problem. I have already presumed too long upon your patience, but there is one other aspect of the problem presented in Mr. "Smith's" letter that I should like to dwell upon, however, briefly. The problem is, how can the Institute contribute to the progress of the country as a whole? It is, I hope, agreed that it must do this by keeping to its proper domain of training men. It is agreed also that for the

most part that training must be along the lines of science and the applications of science to all the actual problems of the Nation. I need not enlarge to you on the merits from the point of view of national need of the Institute's training, but there is one aspect of that training that is in my judgment not sufficiently emphasized even amongst Institute men. The most valuable and permanent results of any training are often what may be described as its by-products. Science is good in itself and the really scientific spirit is of inestimable value. It is valuable to the individual and valuable to the race, and to no race more valuable than to ours. If you look at this country today and compare its condition with the countries with which it must compete after the great war, you must recognize that all the advantages are not on our side. The countries at war are going through a priceless discipline of stern experience. We are in danger of being ruined by a prosperity that is largely accidental, being due in very small measure to any merits of ours, this prosperity encouraging what was always a dangerous feature in our national character,—a spirit of thriftlessness and extravagance. The nations at war are being forced by their circumstances to the utmost economies and the most careful forethought of the morrow. This is enormously to their advantage in the long run, and we shall inevitably suffer, and suffer bitterly, in our competition with others unless we can find means of arresting what appears to be becoming a national habit. Under these circumstances it sometimes seems to me that the greatest merit of a training such as Tech affords is that it not only forces men to look ahead, but produces in them what I may describe as the habit of economy, not in a personal but in a larger sense. The men trained as Tech men are trained to look naturally for means of saving waste and in due time waste becomes so hateful a thing in itself that men's best energies are devoted to avoiding it. This, I think, is one of the reasons why Mr. "Smith" is right in saying that the progress of this country is to be affected

greatly by the men who are trained at the Massachusetts Institute of Technology.

The second speaker, introduced by President Charles A. Stone, '88, was Dr. Willis R. Whitney, '90, member of the United States Naval Consulting Board, whose interesting paper is given below.

#### DR. WHITNEY ON "RESEARCH"

I want to talk about pure research because we Americans seem to know so little about it. Nothing in the world is so important to engineers. Although ours is the greatest engineering school, it is the home of few research men.

Since the war began we have all taken inventories. We see that there is need on every side for national planning which shall extend beyond the four years for which our political parties are separately responsible. Our nation will not mature under a single administration. National policies should be planned for long periods. The part which I want to talk about tonight is the advancement of science, and the improvement of Americans by our Institute.

Because of the inherited conservatism of systematized teaching, radical steps are slow. But William Barton Rogers, in establishing this Institute, did something radical. Men were to be taught by contact with things, instead of being merely told about them by teachers—the custom of a thousand years. A great technical school resulted. It prepares men for useful work in trade and industry, but neither this nor any other American school is doing enough to read the countless uncut pages of science or to lay the foundations of the future engineering structures.

Even if research had no greater value than its application to engineering, much more of it ought to be done at this institution. If working into new levels of Nature's infinite mines merely made students brighter, or teachers more interesting, there would be ample warrant for research. But there are better reasons. Some are instinctive and as difficult of analysis as are our reasons for developing at all.

Man seems to be the supreme, mentally elastic organism. He develops by trying novelties and by taking new paths. No one knows to what extent he may develop, but everyone knows that through acquisition of knowledge, or, let me say, production of it, he may transcend any physical limits. This will not come about by continuous repetition of what we have already learned. Monkeys and parrots do as much. It will come through the continual and active appreciation of new knowledge. In national mental development we might be wise to learn to do as well as Germany has done until we can do better. In most every little town of the Empire there is a university. In almost every university there are several thoughtful professors, and in almost every professor there is a research man of high order. Such has been the condition for two score years. During that time a large part of the basic knowledge of our engineering has come from these people, whether it be the engineering of the physician, the chemist, or the electrician, or the engineering of music, economics, or religion. Every one of these professors delved patiently in his university laboratory, using his own and students' hands, and his lectures were far the lesser part of his work. Such men teach by example, and produce others like themselves by contagion. When the student has in turn contributed to new knowledge, and only then, he may become a doctor, and in Germany this means something real. When this doctor has later shown great originality and productivity, he may become a professor, and that means "*wie ein Gott*"—only a little lower than a Kaiser. Do not make a mistake here, of laughing at the funny foreign facts. Maybe *we* are funny, and slow to see it. When I "*made my doctor*" in Germany, a laurel wreath was put at my place at table. In America, I should have had to buy a box of cigars for the boys.

A professor with us is a conscientious alumnus a little older than his assistants. He is often stunting his mental growth on a salary that a chauffeur would scarcely accept. He is not expected to be a constructive scientist, nor a real worker in



science. He is not asked to show boys how new things may be done by doing a few of them. He must confine himself to talking about accomplishments of others, usually foreigners. We rail at him, but do not help him at all. The fault is not his. He was raised as a part of the system which we, in our poverty, have had to employ.

In the advance of civilization it is new knowledge which paves the way, and the pavement is eternal. While the physical structures of man are decaying, the facts he is learning are ever doing new service. Anti-toxic devices will be increasing when locomotives are forgotten. Magnetic induction will work after the pyramids have blown away. We ought to see that everything distinguishing our lives from those of Indians has come from studying something new.

As we grow in years and wealth, we ought to grow in wisdom and knowledge. H. G. Wells, who wrote "Mr. Britling Sees it Through," once made some notes on Boston which have enough of fair criticism of our immobility to warrant repeating. He says: "There broods over Boston an immense effect of finality. One feels in Boston as one feels in no other part of the states, that the intellectual movement has ceased. . . . Over against unthinking ignorance is scholarly refinement (the spirit of Boston); between that Scylla and this Charybdis the creative mind of man steers its precarious way."

The creative mind of man steers its precarious way, and there is little reason for it but habit. We are not too old to grow the creative mind. England, France, and Germany do it. We here are not too young, because western universities are doing it in some lines.

In many countries there exist today classes of men who devote their lives to public welfare and are kept from starvation by long established customs of community support. They are never satisfied with what is already known, but they themselves want to extend the known with an ardor which is perpetual. They are usually professors.

Most of the foundations of the world's great advances in knowledge have been

laid by men who were set apart and supported by the government, or some more or less public institution, where, for very long periods (usually for life), they were encouraged to delve into the unknown. Think of Davy and Faraday in the Royal Institution; of Graham, Ramsay, Rayleigh, J. J. Thomson, and Kelvin, in English institutions; of Pasteur in the Sorbonne and Pasteur Institute, of the Curies, of Dumas and Berthelot and others of France; of Helmholtz, Bunsen, Hertz, Wöhler, Hofmann, Ostwald, Haber, and others, in German universities; of Berzelius, van't Hoff, Mendeleeff, Arrhenius, and a score of men from the universities of other countries. Most of these are professors of physics or chemistry of our time. They were in some way supported in their research work by their country. How many such cases can we cite for America? In a few colleges, one or two men are now permitted to carry on a little research work, when it does not interfere with routine teaching. It was not long ago that research, if done at all in some of our colleges, had to be done surreptitiously. At this same time, other countries were paying their best scientists to continue research, and schools of research were being maintained in almost every large German and French city.

When Professor Hertz was making observations on the effect of one spark gap on another at a distance, and concluded that he was dealing with electric waves in space, he was not trying to improve the telegraph or telephone. He was like an inquisitive child, making what to him were interesting experiments. He was well trained to observe, but otherwise he was like a youth guided solely by the interest in the new things he was finding. When he had added to knowledge the few simple facts which he observed, he had laid the foundation for a Marconi. His ability was no accident, his service no unsought nor unsupported thing. He had been trained by Helmholtz, and all his life he was employed in German universities to do pure research work and to encourage others to do it likewise. This is the important point.

It is not realized how generally the world's greatest discoveries were disclosed in their first stages by men who were highly trained and experienced in experimenting. I want to emphasize this point. The long strides in advance are made by careful, painstaking observations of matters not at the time particularly promising or comprehensible to the layman. The foundations are most often made by experimenting science professors, who, with mind skilled in observation and keen in appreciation, have had opportunity to long continue the investigation of some phenomenon of Nature which they observed. We Americans must get out of our minds the thought that our part is harvesting the wheat we have grown on our virgin soils. Something has to be cultivated, something planted. We must learn that improvements of great human interest are not accidental, fortuitous, or free from extended exertion.

We are generally superficial. The interesting lives of a few exceptionally able American inventors have led us to over-prize engineering short cuts. We are patenting inventions at the rate of nearly 50,000 a year, but very few Americans are advancing the sciences at all. We need to be told that beneath national supremacy must lie some sort of national foundations, and if we are considering technical, industrial, or engineering supremacy, we must expect to need some constructive work in bases of physics, chemistry, electricity, biology, etc.

The benefits of anaesthesia, for example, are due to the experiments of Priestley on gases, which led Davy to play with nitrous oxide. Then, by experiment, he discovered its power of producing insensibility to pain. Faraday showed that ether acted similarly; Dr. Morton, in Boston, also disclosed its applicability, and, finally, anaesthetics came into general use. The research men were at the time trained chemists merely trying things for the pleasure they obtained in learning something new, and they had been practicing this scientific observation and chemical experimentation all their lives. Thus they appreciated the value of the new facts and tried many experi-

ments to add to the knowledge already gained. And they had time to do it and were paid to do it. In this connection, Sir James Simpson, who introduced chloroform into anaesthesia, early showed a peculiar talent for medical observation and research. He was a well-known professor in Edinburgh, a trained experimenter. If we take a step further back in this field, we find the chloroform itself discovered as a new chemical compound by the well-known university professor, Liebig. He was trained and supported all his life for doing just such things. He was the first of a long series, and he made many such contributions to our welfare.

It is for such reasons that we want to see more chemists and physicists trained in our schools than are absorbed in our present industries. We need them much more generally in scientific research laboratories, in the college or elsewhere, where the country's future interests are concerned.

The trying of new things which made the telephone possible was done by Faraday when he studied the effect of one electric current on another and disclosed the general laws of magnetic induction. His was no untrained mind suddenly awakened by a gracious Nature with a useful discovery in her outstretched hands. He was studying a lot of little effects which all practical men of his day would have said were meaningless and useless. The world holds an infinity of just such phenomena still unstudied, but it does not support many such investigators. Taught to experiment by a Davy, and retained in a position in the Royal Institution, he was in command of his own time and adequate apparatus for scientific research over a period of two score years. This cost the Royal Institution of Great Britain yearly not over \$2500.

People have already nearly forgotten that aeronautics owes its present development to the trying of certain new things by Professor Langley. No one took any stock in his early studies on the rate at which little cardboard planes would fall, if given a certain slant and a certain lateral speed in the air. His studies had