REPORT

OF

THE JOHNS HOPKINS UNIVERSITY

TO THE

GENERAL ASSEMBLY OF MARYLAND

ON THE

TECHNICAL SCHOOL
(DEPARTMENT OF ENGINEERING)

ITS ORGANIZATION, OPERATION, AND THE
AWARD OF STATE SCHOLARSHIPS

JANUARY, 1916
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JANUARY, 1916
To the General Assembly of
the State of Maryland:

The Department of Engineering of the Johns Hopkins University is established under the terms of the Act of the General Assembly of 1912, Chapter 90, commonly known as The Technical School Bill.

The object in view, as stated in the Act, is the extension to the people of the State of opportunities and facilities for education in the applied sciences and advanced technology. Article 43 of the Declaration of Rights of the State is invoked which states that "the Legislature ought to encourage the diffusion of general education and the promotion of the arts, sciences, commerce, manufactures, and the general amelioration of the condition of the people."

In accordance with these aims, the Act provides that the University shall from time to time, offer scholarships in engineering to the young men of the various counties of the State and districts of the City of Baltimore, so that ultimately 129 young men whose financial situation is such that they cannot obtain a technical education without free tuition will at one time be receiving free of charge, a form of education which promises much to them in future years.

The Act also recognizes that an exceptionally advantageous opportunity for the establishment of a school of engineering is offered by the Johns Hopkins University since it already has organized courses suitable for preparation for the study of engineering, leaving only as necessary additions, the buildings, equipment, and teaching staff, necessary for purely engineering subjects.

OPENING OF THE DEPARTMENT OF ENGINEERING.

Immediately on passage of the Bill the University took steps looking to the beginning of the work, and although the appropriations provided by the Act were not available until January 1st, 1913, proper courses were offered and free scholarships were awarded to all applicants who appeared deserving and who were also residents of the State.

By the opening of the year beginning October 1st, 1913, the method of awarding the scholarships had been developed, three pro-
tutions and one which has long and successfully conducted a school of engineering. In view of his broad experience as Constitutional Adviser to the Republic of China, and in his studies of political and economic questions in this country, he has a wide knowledge of both national and international questions. The fact that he warmly advocated the teaching of engineering as an important function of a university makes it certain that no effort will be spared by Johns Hopkins University to carry out the expectations of the State in the establishment of the Department of Engineering.

Thus for example in his inaugural address at Homewood on May 20th, 1915, entitled "Modern Educational Ideals," to an assembly of several thousand people coming from all sections of the United States, and which included public officers, presidents of universities, and other notable people as delegates to the occasion, President Goodnow said in part:

"There are great advantages to be derived from the association of technical schools with universities, particularly where research and investigation, with the idea of enlarging the sum of human knowledge, are recognized as a part of the university's work. A technical school which is completely free from university influence is apt to devote itself exclusively to the imparting of knowledge already existing and is prone to make little if any provision for that research to which advance in knowledge is due * * *. The association of such a school with the university tends to give a greater breadth to professional training. The presence in the University of persons who * * * may be regarded as experts in their particular lines makes it one of the obligations of our higher institutions of learning to proffer the services of their members to the communities in which they are situated * * *. The rendering of public service and the preparation for rendering such service must be regarded as included among modern educational ideals * * *. The educational ideals of the present day then include the application of scientific methods to the conduct of the ordinary affairs of life, * * * and the rendering of public service."
DEDICATION OF THE LABORATORY OF MECHANICAL AND ELECTRICAL ENGINEERING.

ADDRESS BY GENERAL GEORGE W. GOETHALS,
Chief Engineer of the Panama Canal Commission.

The second important event to which attention is drawn was the public dedication of the Laboratory of Mechanical and Electrical Engineering on May 21st, 1915. The exercises were held in the open air at Homewood on May 21st, 1915, in the presence of a notable assembly of official delegates, guests, friends, and alumni of the University. President Wilson had promised his presence but his attendance was prevented at the last moment by the tension in international affairs.

The dedicatory address was delivered by Maj.-General George W. Goethals, Engineer Corps, U. S. A., and Chairman and Chief Engineer of the Panama Canal Commission, and was a stirring description of the importance and dignity of the profession of Engineering. General Goethals endorsed particularly the foundation of a school of Engineering within the State of Maryland and the nature of the provisions of the “Technical School” Bill. He also paid tribute to the characters of the members of the Legislature in the broad-minded and intelligent consideration given the bill when it was before them. The address has been extensively published, but two short abstracts may be noted here:

"The obligation imposed by the law * * * concerning the requirements (for admission) and the course of study appeals strongly to me, for if care be exercised in the selection of students representing the various counties and districts, such will be appointed as are seeking an education, and having some idea of its value, will be earnest in their efforts. This will permit the establishment and maintenance of a higher standard than otherwise might be possible."

"To my mind the State through its legislation and the authorities of the Johns Hopkins University, deserve the highest praise and commendation for the way in which the problems presented have been handled and solved."

(6)
SCOPE OF PRESENT REPORT.

The present report describes the progress which has been made within the last two years in the carrying out of the purposes set forth in the Legislative Act. It describes the work in six general divisions:

I. The Award of Scholarships.
II. The Courses of Instruction.
III. Relation to High Schools of the State.
IV. Buildings and Equipment.
V. Faculty and Present Student Enrollment.
VI. Disbursement of Appropriation.

I. THE AWARD OF SCHOLARSHIPS.

Under the conditions of the Act, scholarships are awarded only to young men whose financial circumstances are such that they could not otherwise obtain an education in engineering. No one who can afford to pay for his education is allowed to usurp the place of one who cannot. Competitive examinations must be held when there is more than one applicant for a scholarship allotted to a particular county or legislative district. Scholarships are allotted to the respective counties and legislative districts in accordance with the number of representatives to the General Assembly. In all cases before a scholarship may be awarded, the Senator of the county or legislative district concerned, must certify as to the financial need of the applicant and his residence in the Senator's county.

Concerning the method of awarding the scholarships the Act creating the Department of Engineering provides as follows:

"The original and subsequent awards of scholarships shall be so arranged, so far as their number and the duration of the courses of the study permit, that substantially the same number of original awards, as distinguished from renewals or re-appointments, shall be made each year, and so that such residents of said counties or legislative districts and graduates of said colleges may at all times hold the number of such scholarships to which they are entitled, and so that the
number of said scholarships so held at one time may as nearly as possible be equal to but shall not exceed one hundred and twenty-nine scholarships."

The purpose of this provision is evident. If all of the scholarships had been awarded to young men graduating from the high schools of the State the first year, and it took four years to educate these young men, there would be a period of four years before any other young men graduating from the high schools would have an opportunity for free education. At the end of this period another one hundred and twenty-nine scholarships would have been awarded and another injustice perpetrated. The bill contemplated, therefore, that so far as mathematically possible, the same number of awards should be made each year.

In carrying out the above and other provisions of the Act, the University has advertised both in the spring and fall, in the newspapers of every county of the State, at least one month in advance, the date on which the entrance examinations to the University and the competitive scholarship examinations were to be held.

As the applications are received they are classified as to residence of the applicants, and in many cases correspondence has been carried on with Senators, high school principals, and parents. This correspondence has aided materially in the proper carrying out of the conditions under which the scholarships are awarded.

The results of the competitive examinations have been forwarded promptly to the respective Senators and at the same time have been published in the newspapers of the respective counties. The awards of the scholarships have been made and announced as soon as recommendations and certifications from the Senators have been received.

In accordance with the provisions of the Act, the appointments to scholarships have been made for one year only, but the scholarships are renewable from year to year if the applicant conforms to the rules and standards of the University. It is a pleasure to record that the cases in which it has been found necessary to withhold re-appointments have been comparatively few. A complete statement of the award of scholarships is given below.

The Senatorial Scholarships, one in each County and Legislative District, which carry with them $200 in lieu of board and lodging, have been awarded on the special recommendation of the
FIGURE 4.—SWITCHBOARD FOR ELECTRIC LIGHTING AND POWER
respective Senators. It is understood that these scholarships are intended only for especially deserving young men. The University has naturally been dependent upon the assistance of the Senators in carrying out this intent and is glad to say that in most of the cases it appears that the results of these awards have been in accordance with the purposes for which the Senatorial Scholarship has been created, namely, that exceptionally worthy young men should receive its benefits.

In no case has a State scholarship been awarded without the certificate of the Senator from the county in which the applicant resided, to the effect that the applicant was a bona fide resident of the county named, and that the applicant's financial circumstances were such that he was unable to procure a technical education without free tuition. All of the Senators have conscientiously assumed this duty imposed upon them, and so far as the University has been able to determine, have been scrupulously careful to see that no applicant is awarded a scholarship who is able to pay for his education. The University earnestly urges a continuation of this rigorous scrutiny, as otherwise young men with no other available means of securing an education will be pushed aside in favor of those who are able to pay.

The result of the financial test so far has been thoroughly satisfactory. It is also gratifying to note that all of the professors into whose courses the scholarship men have entered have spoken in the most favorable way of the high average of character, earnestness and ability. We congratulate ourselves and the State on the effective methods provided in the bill for securing an education for the poorer boys of the State who are really in earnest in their desire to receive the benefits of a technical education.

Following is a tabulated statement of the award of scholarships up to this time:

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The above list contains 94 names. In addition there are three students in Engineering who by reason of special circumstances have been appointed by the Trustees to scholarships of other types. The total number of scholarships now awarded to students in Engineering is, therefore, 97.

Attention has already been drawn to the provision of the Act requiring that as nearly as possible the same number of scholarships be awarded each year. Remembering that the present year is the third and that the course extends through four years, it will be seen that there should be approximately 96 scholarships available as of this year. As 97 have been awarded it will be seen that the list is
complete. While a few available county scholarships are vacant, the total list is more than filled by the special scholarships designated 1912-13 in the above list, which were awarded by the Trustees to all deserving applicants in October, 1912, before the new school was completely organized. It should also be noted that if all the counties had sent the permissible number of applicants the number of awards would have been greater.

In 1913 there were 92 applicants for scholarships and 53 awards; in 1914 there were 39 applicants and 22 new awards; in 1915 there were 61 applicants and 27 new awards. Those applying who did not receive awards were eliminated either by the entrance or the competitive examinations.

It will be readily seen, therefore, that one of the principal aims of the Act, namely, to provide opportunity for education in engineering to young men of the State without expense, has been reached almost at the outset. There is every indication that with a continuance of the interest that has been shown in these scholarships up to this time, the number of scholarships awarded will always be very nearly equal to, if it does not exceed, the number to which the State is entitled. In view of the short period in which the school has been organized this fact is a notable indication of the wisdom of creating the opportunities afforded in these scholarships.

Following are a few interesting facts in connection with the scholarships:

**Total Number of Awards:** Since the opening of the Department a total number of 123 scholarships have been awarded. Of these 1 has been vacated by graduation, 1 by death, and there have been 25 withdrawals. The withdrawals have, in a few cases, been for the purpose of entering outside employment. The remainder have been due to inadequate preparation or inability to keep up with the work. These vacancies are automatically filled in the following term.

**Counties Represented:** Scholarships have been awarded to residents of all four legislative districts of Baltimore City and to every county in the State except one, Wicomico. The present list shows a vacancy in only one other county, to wit, Howard.

**Scholarships at Large:** At present five of the six scholarships "At Large" have been awarded.

**College Scholarships:** Scholarships have been awarded to grad-
FIGURE 6—STORAGE BATTERY
uates of each of the seven colleges of Maryland mentioned in the Act. At present Loyola College alone has no representative.

**Senatorial Scholarships:** The Senatorial Scholarship as shown by the above list has been awarded in four districts of Baltimore City and in nineteen counties of the State. The counties in which the award was not made this year are Howard, Kent, Talbot and Wicomico. We urge those in authority in these counties to call the attention of students to the opportunity afforded by the Senatorial scholarships.

Of the scholarships available each year, nearly all have been awarded. In a few cases there have been no applicants. Much pressure has been brought upon the University to award these vacant scholarships to residents of other counties. Such action is clearly and most wisely forbidden by the Legislative Bill. If it were possible to make awards in this way the counties which have boys specially prepared in one year would usurp the rights for the four succeeding of those counties which in the one year referred to, happened to have no candidate. This would lead to great confusion and unequal distribution of the benefits of the scholarships, and would result further in the necessity of withdrawing a scholarship already awarded before a young man had completed his work, or to an unequal distribution of scholarships.

**II. COURSES OF INSTRUCTION.**

The University has given extensive consideration to the planning of courses of study. As outlined in the report of 1914, advice was asked from many practising engineers and manufacturers, as well as from the faculties of existing technical schools, as to what features could be adopted with best advantage, to correct existing difficulties or criticisms in the present methods of education in other schools. It was found in this class of investigation that there was an almost universal opinion that the graduate in engineering of today is not sufficiently trained in powers of expression, in general educational subjects, and in the scientific principles underlying the practice of engineering. The feeling is that these necessities have been sacrificed in the attempt to train the student in all of the special applications of his particular branch of engineering.

The undergraduate course as adopted, therefore, extends through
four years, the first two of which are devoted to training in general educational subjects with special insistence on the sciences underlying engineering. The purely professional studies begin in the third year and extend through two years to graduation. A course in surveying is conducted in the summer months following the second year. In the summer between the third and fourth years, effort has been made to locate the students in existing manufacturing and engineering organizations, this plan having met with much success in the summer of 1915.

The general plan of the courses as briefly outlined above, has been widely announced and discussed by leading educators and engineers, and has received most general commendation as being in accordance with the present needs for education for the profession of engineering. Our aim has been to make the degree of engineering at the Johns Hopkins University stand relatively as high in the engineering world as the medical degree now stands. If we can accomplish this we will have conferred a great practical benefit to the young men of this State who have held the State scholarships.

While the first efforts of the University have been devoted to the organization of the undergraduate courses, it has not been forgotten that the Legislative Bill contemplated the establishment of courses in "advanced technology." The evident purpose here is that the present reputation of Johns Hopkins in the graduate field in other subjects might be sustained also in the field of engineering. With this end in view, graduate courses have been announced and preparations made for the advanced laboratory and experimental work in conjunction therewith. Up to this time no particular effort has been made to announce the opportunities and facilities thus offered, but at present there are enrolled in the department 19 graduates of other institutions. Of these 14 are following undergraduate courses and five are following graduate courses and are engaged in advanced experimental work.

In connection with the regular courses of study the plans of the department contemplate lectures by engineers engaged in the practice of the profession. While this feature of the work has also not yet been completely organized a number of lectures have already been delivered under the auspices of the department by men particularly qualified to speak on the respective subjects. A list of these speakers and their subjects, is as follows:
FIGURE 7.—PART OF THE CIVIL ENGINEERING LABORATORY
Mr. Harrington Emerson, four lectures, "Industrial Efficiency."
Mr. C. R. Underhill, "Electro Magnets."
Mr. F. H. Wagner, "By-Products of Gas Manufacture."
Mr. H. H. Hower, "The Knight Sleeve Gasoline Motor."

The extensive interest in gas manufacture and by-product recovery has led to the arrangement of a regular course of lectures and laboratory practice by Mr. Wagner, for fourth year and graduate students. Mr. Wagner is chief engineer of a prominent commercial engineering organization of Baltimore, a graduate of the Royal Polytechnicum of Karlsruhe, Germany, and is recognized as a leading authority in the United States, on the subject of this course. He has been appointed by the Trustees as special lecturer on by-product recovery and is generously giving his time to the work without compensation. He is assisted by Mr. Billings, a member of the faculty of Mechanical Engineering. Much interest in this course arises from the fact that it deals with the production of analine dyes, explosives, and other valuable articles of commerce for which we have thus far been dependent upon foreign countries. It is hoped that equipment and further facilities will be obtained so that young men may be adequately prepared to enter this line of industry.

The monthly meetings of the Baltimore Section of the American Institute of Electrical Engineers are held in the buildings of the University and are open to the student body. Each of the three professors of Engineering is a member of an important committee of the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers, respectively, and participates actively in the work of those bodies.

III. RELATION TO HIGH SCHOOLS OF THE STATE.

It has been hoped that one of the most valuable consequences of the establishment of the Department of Engineering would be the stimulus to the work of the high schools of the State. The established graduating requirements of the high schools, as set forth by the Board of Education, are wider in extent than the requirements for entrance to the University. Consequently, any student who has graduated from an approved State high school, conducting a full curriculum, should have no difficulty in securing entrance to the University.
Unfortunately, however, not all of the high schools of the State have a sufficient number of teachers to conduct all of the courses in the approved curriculum. There are also apparently some differences in the methods of instruction in the various schools and in the standards exacted for graduation. As a consequence it has been found that some graduates of high schools are not completely prepared to undertake the courses in the Department of Engineering and also that there is a considerable variation in the quality of work of those who have followed courses which should equip them to undertake the prescribed work in the University.

Admission of Graduates of High Schools to the Department of Engineering.

Realizing that this situation was more or less a natural one, the University has adopted two methods in an effort to obviate the difficulty. First, it has temporarily adopted a plan of admitting with credits in certain subjects, those graduates of high schools who are specially recommended for this action by the respective principals. This has been done in the case of those schools from which the University has never had students, and about which, therefore, it could have but limited information. In the past, under the rules of the University, a candidate from such a school would be required to take a full entrance examination. It has appeared advisable to the University, however, in order to encourage a better relation with the schools, and in order to facilitate the prompt carrying out of the intent of the Act, to adopt the plan described for one or two years at least, so that information can be quickly obtained as to the general character of the graduates from the various schools. If the students to whom these credits have been allowed follow the work without particular difficulty it will be an indication that the school from which they came prepares them suitably, and it is the hope, that in the future it will not be necessary to examine any graduates from such a school.

Visits to High Schools.

The second method that has been adopted to promote co-operation with the high schools is an extensive study and investigation of the work which the high schools are doing. This study has been largely carried out by Professor Edward F. Buchner, of the Depart-
FIGURE 9 - COMPLETE STEAM ELECTRIC UNIT IN THE MECHANICAL ENGINEERING LABORATORY
ment of Education of the University. Professor Buchner's wide acquaintance with the schools of the State, his identification with the various teachers' organizations, and his wide experience in questions of education lend especial value to his report of his work in this connection which is given below:

Report of Professor Edward F. Buchner.

The field of secondary education in Maryland and its relation to the University have received attention since the report two years ago. The plan of personal visitation has been widened by the addition of several important means which have proved increasingly serviceable in bringing about more intelligent and cordial relations between the high schools and the University.

Two special studies on important conditions in our high schools have been presented to the department of secondary education of the Maryland State Teachers' Association. At the meeting in Annapolis in 1913, the results of a detailed study of the preparation and experiences of secondary teachers, the low salary basis upon which this work was placed, and especially the organization of instruction in the high schools, as indicated by a comparative study of programs and schedules, were presented. The interpretation given to these data were designed to indicate the next important steps that should be taken in order to bring about an improvement in the teaching of those students who are expecting to take up engineering studies at the University. It was urged that the normal requirements of the Department of Engineering as set forth in the Bill could not be readily met by a continuance of some of the more prevalent conditions surrounding high school teaching.

At a meeting of the Maryland State Teachers' Association at Ocean City in 1914, the results of a further study of our high schools were presented. After two years' experience in admitting high school graduates to the University, and in instruction in branches leading to the work in engineering, the records of students in passing entrance examinations and courses of instruction in the University constituted wholly new material for the study of the work of the high schools. This material included the results of the three entrance examinations which had been held from 1912 to 1914, and the scholarship standing of the students who had been at the University during the two years and one year, respectively. In order to bring to light
the important facts respecting the State system of high schools, the
data studied were arranged in three groups: (1) The Baltimore
City College and Polytechnic Institute, (2) institutions outside of
Maryland, (3) the Maryland county high schools. A general im-
pression that the three different groups of schools could not be doing
the same grade of work was current. The study, however, clearly
showed that the students admitted to the University from the county
high schools sustained themselves on the whole, as satisfactorily as
those who came from the first and second group. At the same time
there was an indication that improvement in the secondary teaching
in English, mathematics, German, and physics is desirable. At the
meeting of the Association in 1912, at Braddock Heights, a report
was presented showing a provisional professional rating of the high
schools as judged by the efficiency of their work. This rating was
corroborated by the results of the study of 1914, which was based
on the achievement of these students at the University. It was found
to be rather striking that the ranking of the schools as they were two
years ago has been well sustained by the achievement of those of
their representatives who have met the entrance requirements to the
University and carried courses of instruction during one or two
years.

The programs of many other meetings of teachers have afforded
opportunities which have been utilized to present different phases of
the relationship between the high schools and the Department of
Engineering. These have included the annual meetings of the Asso-
ciation of Maryland High School Teachers, of the County Superin-
tendents, and of the Association of County School Commissioners.
A number of annual county institutes for teachers have been utilized
for the purpose of bringing the features of the Department of En-
gineering to school officials and teachers. Special visits which in-
cluded addresses on the Department of Engineering were made in
1914 to the joint institutes of the teachers of Charles, Montgomery,
Prince George's and St. Mary's counties at Washington, D. C., and
to the Washington County Teachers' Institute at Hagerstown. Dur-
ing the entire week at the Allegany County Teachers' Institute in
Cumberland in 1913, the week at the joint institute of Montgomery,
Prince George's and St. Mary’s counties at College Park in 1914,
and the two weeks at the Prince George's County Institute at Hyatts-
ville in 1915, additional opportunities were offered for disseminating
information concerning the course of study and the scholarships in

(18)
FIGURE 10 - GAS ANALYSIS ROOM, MECHANICAL ENGINEERING LABORATORY
the school of Engineering and the entrance requirements in so far as they concerned the work of instruction in the high schools.

A number of addresses on the Department of Engineering, requested by special invitation, were given in 1914: at the annual meeting of the Alumni Association of the Maryland Institute at the City Club, Baltimore, February 17th; before the faculty and students of the Western High School, Washington, D. C., March 20th, illustrated with lantern slides (as arranged by University Alumni in that city); at the annual meeting of the Alumni Association of Rock Hill College, May 16. The features of the School of Engineering were also mentioned in commencement addresses given at Salisbury, Denton, Jarrettsville, Towson, and Sparrows Point high schools, and at the Frostburg Normal School. The visit, upon invitation, to the spring meeting of the Potomac Valley Teachers' Round Table, which includes many Maryland high school teachers, held at Charlestown, West Virginia, April 24th, offered another opportunity to speak of the features of the Department of Engineering. Personal visits have been made to the high schools at Crisfield, Princess Anne, Delmar, Elkton, Chesapeake City, North East, Marlboro, Clinton, Centerville, Denton, Salisbury, Frederick, Hagerstown, Bel Air and Baden.

In order to facilitate a continuous study of high school conditions in the State, a special blank for recording annually the data concerning the faculty, equipment, and instruction given in each high school, was provided in the spring of 1914. The blank was elaborated in cooperation with Dr. M. Bates Stephens, State Superintendent, and Mr. B. K. Purdam, Assistant Superintendent of Education, and its use has been welcomed on the part of the schools.

Another means of co-ordinating more effectively the Department of Engineering and the high schools has been the tabulation of the merits of particular high schools, which send students to the University, by careful study of the scholarship records which they establish. It may, therefore, be said that there are now in use three methods of studying high school conditions in the State as they affect the Department of Engineering. First, personal visitation, which studies the instruction and the local arrangements for the organization of the secondary work, and personal conference on special problems and difficulties; second, the detailed statement by the teachers as to the actual amount of work accomplished by their classes in the different parts of the course of study in the given year; and third, the state-
ment of the records made by students admitted to the University and in attendance. The development of these several means has been found necessary because of the extreme difficulty in securing and recording an adequate and accurate judgment of the work accomplished in the four years of high school instruction. This difficulty has been confirmed by the experiences of the State Department of Education. It is believed that only through a judicious use of the material gathered by these means can a fair interpretation of the work of the high schools be secured.

As a further expression of the cordial attitude of the University towards the high school individually and collectively, there was published in March, 1915, a pamphlet presenting "Suggestions to High School Teachers." This was prepared in response to numerous inquiries from the county superintendents and principals concerning the entrance requirements of the University, which had naturally increased after the enactment of the "Technical School" Bill of 1912. It was the purpose of the University in issuing these suggestions to state briefly "the chief points which should receive emphasis in the teaching of each subject, in the hope that there will be an improvement in the quality of the preparation of students coming to the University" from the Maryland high schools. These statements were based on the course of study as modified in 1913, and were prepared by the representatives, respectively, of the several departments of the University. This pamphlet has been distributed to the school officials and high school teachers throughout the State, by whom it has been apparently welcomed. Also, it has been bound with the circulars of the engineering and the collegiate departments and placed for reference in the school offices throughout the State.

It is a special pleasure to be able to report that in several high schools studies are being made by the staffs with a view to improvement of the details in the course of study and of the methods of handling the subject matter. Throughout the State there is apparent earnest co-operation and enthusiasm on the part of the superintendents, principals and teachers in securing reasonable and substantial progress in secondary instruction.

Visits to the High Schools by the Professors of Engineering.

In addition to the numerous visits made to the high schools by Professor Buchner, Professors Thomas, Tilden and Whitehead of
FIGURE 11: GENERAL VIEW OF CIVIL ENGINEERING BUILDING
the Faculty of Engineering, have also made a series of independent visits to the high schools. These visits have been largely for the purpose of calling the attention of the principals and students to the advantages of the scholarships in the Department of Engineering, and of the exceptional facilities for the study of the engineering profession thus opened.

Visits of this character have been made to seventeen high schools in the counties of the State, not including visits to schools in Baltimore City. In these visits the question of the relation of the graduating requirements of the high schools and the entrance requirements of the University, past difficulties with students, and general plans for co-operation have been discussed. In many cases addresses have been made to the student body in which the advantages of the scholarships and the conditions under which the awards can be made have been explained. Often personal interviews have followed and there can be no doubt that these visits have resulted in increased mutual understanding and a general intention that advantage be taken of the opportunities offered by the State in the scholarships.

These visits will be continued from time to time as favorable opportunity offers. Correspondence with principals of schools, which arises in connection with individual students, often leads to the arranging of visits of the above character on such occasions when the objects in view offer best opportunities for accomplishment.

IV. BUILDINGS AND EQUIPMENT.

It will be recalled that the report of 1914 stated that there would be two main buildings for the work in the Department of Engineering:

A—The Laboratory of Mechanical and Electrical Engineering, and
B—The Laboratory of Civil Engineering.

At that time the former was in process of construction and the report included a number of drawings showing the floor plans, cross-sections, and elevations of the building. A description was also given of the approximate future plans of the Laboratory of Civil Engineering.
Laboratory of Mechanical and Electrical Engineering.

This building was completed in the summer of 1914, and all of the courses and laboratory work in Engineering have been conducted in it since the opening of the teaching year in 1914. A general view of the building is shown in the frontispiece of this report. A number of other photographs of interior views, showing also some of the equipment are distributed through the body of the report.

The main part of the building comprises two full stories, basement and attic. Machinery Hall adjoins the two end wings and forms the rear of the building. It is a large laboratory for machinery, approximately 200 feet long, by 50 feet wide, and 24 feet high under the roof trusses. It is well lighted and ventilated by means of monitor sky-lights, and large windows of factory type on all sides. It contains a travelling crane for the handling of machinery and the necessary switch-board for controlling all of the light, power and experimental electric circuits in the building. The concrete floor is fitted with bed-plates for attaching machinery of various types and suitable for permitting such alterations of the arrangement of machinery as may be desired. The laboratory is especially designed with a view to temporarily installing machines owned by manufacturing firms and for removing these upon completion of the tests. There is also a gallery extending the full length of Machinery Hall which will be used for certain classes of experimental work requiring long distances, as for example the properties of electric transmission lines. Views of Machinery Hall are shown in Figures 1, 2, 3 and 4.

The basement proper is at the same level and connects with the main floors of Machinery Hall by means of two end wings. It contains a mechanic's shop, store room, storage battery room, space for ventilating fans, locker and toilet rooms, as well as several rooms for special experimental work in the two branches, Electrical and Mechanical Engineering. Views of the shop and storage battery rooms are shown in Figures 5 and 6. During the past and present years, pending the erection of a special building, the work in Civil Engineering has been conducted in this building. A portion of the equipment located in the basement is shown in Figure 7.

The first floor includes an auditorium or main lecture room, which will seat 150 people, large laboratories for electrical measurements with store room adjoining, instrument testing laboratories, drawing rooms for advanced students, a room for students' engineer-
FIGURE 12—CIVIL ENGINEERING BUILDING. BASEMENT PLAN
ing societies, three class rooms and several smaller rooms for special purposes.

The second floor includes two large drawing rooms, a library and reading room, two rooms devoted to the study of artificial illumination, the laboratory of wireless telegraphy, professors’ offices and several rooms for special research. A view of one of the drawing rooms is shown in Figure 8.

There is an attic of good elevation. It is as yet unfinished but will provide an excellent space for certain purposes in the expanding needs of the department.

Liberal provision has been made for the distribution of electric power of all types to all parts of the building. All sources of power from the various machines in the power station and in Machinery Hall are centered at the main switch-board, and from there are distributed over special experimental circuits run through the tunnels beneath the basement and up a number of wire shafts, to panel boards located on the various floors. Provision is also made for the distribution of steam, water, gas and compressed air, to several laboratories in the basement.

Much progress has been made in equipping the various laboratories. The design and purchase of equipment is still under way but at present there is available apparatus of the best modern type for experiments in photometry, high voltage, electrolysis, dynamos and motors, transmission of power, fuel testing, dynamometers, wire testing, refrigeration, measurement of air, testing of materials, hydraulics, etc. Advantage has been taken of the high point afforded by the chimney of the power station of the University to install an antenna for radio telegraphy over 300 feet long, the opposite end being attached to the north wing of the laboratory building.

The building faces the west on the south quadrangle of the Homewood development and is conveniently situated with regard to the other buildings of the University as now planned. Directly opposite on the south quadrangle, is the Civil Engineering Building, now in process of construction. The power plant which furnishes light, heat and power is also near by.

In recognition of the action of the State which made possible the establishment of the Department of Engineering, the center of the west facade is embellished by a large coat of arms of the State of Maryland carved from white marble.
Laboratory Equipment in Power Plant.

Certain parts of the experimental equipment which are noisy in operation and which require the consumption of coal, gas and live steam, have been located in the power station. This plan not only removes noisy equipment from the proximity of class rooms but enables their operation to be conducted more economically. This class of equipment comprises the various gas and oil engines, the gas producers, and a steam locomobile. The last named is a single unit consisting of steam boiler, steam engine, and electric generator, and forms a complete separate plant of which the students can be put in entire charge, having under their control all elements of both fuel supply and power output.

The power plant has also been equipped in various places with measuring equipment so that in its operation in supplying the University buildings with light, heat and power, it may also be used for the purposes of experiment and instruction.

The power station and the Laboratory of Mechanical and Electrical Engineering are connected by an underground tunnel through which the various electric circuits, steam and water pipes are carried.

Laboratory of Civil Engineering.

The building for the use of the department of Civil Engineering is now under construction. It is situated about 160 feet due west from the building now occupied by the departments of Mechanical and Electrical Engineering, and covers a total area in plan, of 14,340 square feet, exclusive of the open area way in front which is designed to give light and air to the basement rooms on the east side. The building is 204 feet, 9 inches in length and comprises three stories in addition to the basement. It has been planned so that at any future time, an extensive addition may be made to the westward to accommodate either another branch of engineering or to take care of the growth in the work in the present department.

The four floor plans, a perspective view of the building, and two sections, one longitudinal on a north and south line, and the other on an east and west line through the lecture room, are shown herewith (see Figs. 10-16). In the basement three large laboratories are provided, one each for the three divisions into which the work of instruction and research in Civil Engineering is divided. In the central portion of the building, in the wing which extends 47 feet
FIGURE 13 - CIVIL ENGINEERING BUILDING, FIRST FLOOR PLAN
to the westward, is the main structures laboratory comprising a large room of 2,060 square feet, and a research room with 480, making a total of 2,540 square feet devoted to investigative work and laboratory instruction in the structural division of Civil Engineering. Here will be located the principal machines used for testing the various materials of construction, such as steel, iron, timber, stone and concrete, and also equipment for making the necessary tests of cement and sand.

At the southern end of the basement is the hydraulic laboratory consisting of a long room with especially designed channels, measuring bays, and standpipes for experiments on the flow of water, and a research room which will be particularly devoted to studies in sanitary engineering such as the chemical and bacteriological analyses of water and sewage. The main laboratory for hydraulics covers 1,630 square feet, and the research room 680, making a total of 2,310 square feet. In the north end of the basement are the two similar rooms devoted to transportation problems which, in the field of Civil Engineering are concerned principally with highway and canal construction, the physical elements of steam and electric railway lines and in general the structural features of all that has to do with systems of transportation. The main laboratory has an area of 1,700 square feet and the research room connected with it 480, making a total of 2,180 square feet. In the basement also are the student toilet and locker rooms, a shop, a small private laboratory and a room of about 480 square feet in area which will be used for surveying instruments.

The main entrance of the building is the central feature of the first floor plan. On either side of this entrance are offices opening out of the corridor, and directly across this corridor is the main lecture room covering a floor space of some 2,530 square feet, and giving room for seating an audience of 350 or 400. Ample class room space is also provided on this floor and there are entrances to the building at each end of the main corridor. It is planned to fit up one of the class rooms with special apparatus for demonstrating the more important principles of applied mechanics.

On the second floor the main divisions correspond with the similar divisions in the basement plans. At either end of the building and in the central wings are large drafting rooms. The department's growing collection of topographic and other maps will be kept in the room at the south end. Owing to the fact that the large
central drafting room extends directly to the roof, the space on the third floor is considerably curtailed. A dark room and a blue print room are the principal divisions on this floor. At either end are two good sized and well lighted rooms, one of which may be used as a museum, and the other as headquarters for a Civil Engineering Club, while the long room extending across the front has not as yet been assigned.

The architect of the building is Mr. Joseph Evans Sperry, of Baltimore, who designed the laboratory of Mechanical and Electrical Engineering. The contract for construction has been let to the Consolidated Engineering Company, also of Baltimore, and this contract calls for completion by August 15th, 1916.

V. FACULTY AND STUDENT ENROLLMENT.

Since the report to the Legislature of 1914, the faculty of Engineering has been increased by six associate professors and instructors. It will be recalled that the initial faculty consisted of three professors of the branches, Civil, Electrical, and Mechanical Engineering, respectively. The increase in members has been necessary in order to meet the increasing size of the student body. The faculty as now organized consists of a professor and two assistant members in each branch of Engineering.

The members of the faculty have all been chosen after careful study of their qualifications for the special character of work already outlined for the Department of Engineering. It will be recalled that it is planned to make certain departures from the methods of education in engineering which are in most common use today. In the selection of members of the faculty care has been taken to ascertain whether each one was in sympathy with these aims and so could devote his best efforts to their furtherance.

The University is glad to state that the faculty has entered into its new work with great enthusiasm. Not only have extensive tangible results been reached in the construction of the buildings and the installation of experimental equipment as the direct result of the efforts of the new faculty, but more important, the courses of study have been organized and the whole system of instruction put under way. Attention has already been drawn to the organization of the system under which the scholarships are awarded to deserving young men of the State.
Figure 14: Civil Engineering Building, Second Floor Plan
Faculty

Following is a list of the members of the faculty with brief statements as to their training and teaching experiences. Each member of the faculty has had a greater or less experience in the actual practice of his profession, in addition to his educational training.

CARL CLAPP THOMAS, M.E., Professor of Mechanical Engineering.
M.E., Cornell University, 1895; Professor of Marine Engineering, Cornell University, 1904-08; Professor of Steam and Gas Engineering, University of Wisconsin, 1908-13. Member, American Society of Mechanical Engineers, American Society of Naval Architects and Marine Engineers, The American Gas Institute.

CHARLES JOSEPH TILDEN, S.B., Professor of Civil Engineering.
A.B., Harvard University, 1896; Instructor in Civil Engineering, Cornell University, 1903-05; Professor of Engineering Mechanics, University of Michigan, 1911-13. Member, American Society of Civil Engineers.

JOHN BOSWELL WHITEHEAD, PH. D., Professor of Electrical Engineering.
Proficient in Applied Electricity, Johns Hopkins University, 1893, A.B., 1898, and Ph.D., 1902. Fellow and Chairman Electro-Physics Committee, American Institute of Electrical Engineers.

ALEXANDER GRAHAM CHRISTIE, M.E., Associate Professor of Mechanical Engineering.
Diploma in Engineering, University of Toronto, 1901, and M.E., 1912; Instructor, Cornell University, 1904-05; Associate Professor of Steam and Gas Engineering, University of Wisconsin, 1909-14. Member, American Society of Mechanical Engineers.

GRANVILLE REYNARD JONES, C. I.E., S.B., Associate in Civil Engineering.
C.E., Ohio State University, 1904; S.B., Massachusetts Institute of Technology, 1907; Professor of Sanitary Engineering, University of Kansas, 1912-14. Member, American Society of Civil Engineers.

WILLIAM B. KOUWENHOVEN, DR. ING., Instructor in Electrical Engineering.
M.E., Brooklyn Polytechnic Institute, 1907, and E.E., 1908; Doktor-Ingenieur, Karlsruhe, Germany, 1913; Instructor in Electrical Engineering, Brooklyn Polytechnic Institute, 1907; Instructor in Electrical Engineering, Washington University, 1913-14. Member, American Institute Electrical Engineers.

MYRICK WHITING PULLEN, S.B., Instructor in Electrical Engineering.
S.B., in E.E., Iowa State College, 1908, and Instructor, 1908-10.

FRANK LLOYD WEAVER, B.C.E., Instructor in Civil Engineering.
B.C.E., University of Michigan, 1913; Instructor, University of Oklahoma, 1913-14.
JOHN HARLAND BILLINGS, B. A. Sc., M. S., Instructor in Mechanical Engineering.

B. A. Sc., University of Toronto, 1912; M. S., Harvard University and Massachusetts Institute of Technology, 1915; Instructor in the University of Missouri, 1913-14.

Student Enrollment.

Following is a summary of the students enrolled in the Department of Engineering at the opening of the year 1915-16. The separation into the respective groups based on the character of courses followed, is also given.

Of the total enrollment of 148 students, 145 are from Maryland. It will be recalled that when the Act was under discussion it was pointed out that a number of students left the State to study engineering subjects. The figures given indicate that immediate advantage is being taken by the residents of the State of the opportunities for obtaining this character of education nearer home. The advantages of the Department of Engineering have not yet been described through the states to the south of Maryland. It is planned to do this as soon as the more pressing problems of organization have been completed and it is confidently expected that an increase in the number of students from outside the State will then follow.

In considering the number of students at present enrolled, it will be recalled that the Department is now only beginning the third year of its formal organization. The class which will graduate in 1916 contains 11 students who entered in October, 1912, before the courses in Engineering had been organized. It will be seen, therefore, that the enrollment of students in the new school when the first four classes are entered should approximate 200. This enrollment will have come about without effort to advertise the school and the prospect in this respect has surpassed the expectations of those who have been engaged in the organization of the work.

Not only has the initial enrollment been greater than was expected but the character of the work as done by the students, particularly those in later years has been of high character and a most gratifying indication that the new features embodied in the curriculum have been wisely chosen. There is already good indication that graduates of the Department of Engineering of the University will be exceptionally well prepared for entering the practice of the profession.
FIGURE 15 - CIVIL ENGINEERING BUILDING, THIRD FLOOR PLAN

- Museum
- Corridor
- Blue Print Room
- Dark Room
- Civil Engineers Club
- Upper Part Drawing Room
Enrollment in 1915-16.

I. Graduate Students:
   1. Following Advanced Courses - 4
   2. Candidates for degree Bachelor of Science in Engineering - 15

II. Undergraduate Students:
   1. Candidates for degree Bachelor of Science in Engineering - 104
   2. Candidates for Matriculation 24 and 1 special student - 25

Total - 148

Neither the State of Maryland nor any of the states south of the Mason and Dixon line, prior to the Act of the Maryland legislature in 1912, offered proper opportunity for the training of young men in the higher branches of technical education. When it is realized that the industrial and manufacturing prosperity of communities is vitally dependent upon technically trained men, the great industrial significance of the Act of 1912 becomes evident. There are now 148 young men, practically all from Maryland, selected because of their special ability and earnestness, in training at the Johns Hopkins University, to become railroad builders, constructors and operators of gas and electric plants, and experts in all the allied industries dependent upon mechanical, electrical and civil engineering. The effect upon this State and the South should be very stimulating when these young men have graduated and begun the practice of their profession.

It is also proper to indicate that those who advocated this action on the part of the Maryland legislature on the ground that it was a great if unspoken need on the part of the young men of this State, have found solid justification of their views in the large number of students already enrolled in this department.

VI. DISBURSEMENT OF APPROPRIATION.

Following is the statement of the Treasurer of the University, as to the expenditures of the appropriation for buildings and equipment to December 1st, 1915:

(20)
The appropriation of the Legislative Act for Buildings and Equipment... $600,000.00
Less Expenses for Advertising Loan and Engraving Bonds... 670.15

Net Cash received from State Treasurer... $599,329.85

Expended to date for Buildings and Equipment:
- Mechanical and Electrical Engineering Building, Including Heating... 291,136.93
- Mechanical and Electrical Engineering Building Heating Tunnels from Power House and Sewers... 5,125.00
- Power House—Cost of increased size to permit installation of Mechanical Engineering Equipment... 15,000.00

Equipment purchased for Mechanical, Civil and Electrical Engineering:
- Equipment installed in Mechanical and Electrical Engineering Building... $62,903.42
- Equipment installed in Power House and Heating Tunnels to Mechanical and Electrical Building... 29,710.00

Civil Engineering Building Expended to date... 1,155.51

Total expended to date... $405,030.86

Budget of Appropriations for Buildings and Equipment:
- Contracts awarded for Civil Engineering Building... 173,781.22
- Contracts for Civil Engineering Building not yet awarded... 6,218.78
- Balance of Appropriation remaining for equipment ordered or to be purchased during current year... 14,298.99

Total, as per net cash received from State Treasurer... $599,329.85
FIGURE 16. CIVIL ENGINEERING BUILDING, CENTRAL SECTION, EAST AND WEST
Pending the completion of the buildings and the installation of the experimental equipment, the balance of the appropriation in hand has been invested in short term, high grade securities. Interest from these securities is being reserved to provide additional equipment as needed since it has been found that the original appropriation will fall somewhat short of the amount necessary for the complete experimental equipment of three branches of engineering. It has been the policy of the University to purchase the equipment gradually when its need was definitely ascertained and only after careful design and selection. In many cases special discounts have been obtained. On completion of the building and installation of the equipment a complete and detailed statement of the expenditures of the Appropriation will be made to the Board of Public Works.
FIGURE 17—CIVIL ENGINEERING BUILDING, CENTRAL SECTION, NORTH AND SOUTH