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The Wisconsin Engineer

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Mexican Laborers at Work.

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CONTENTS

NOVEMBER, 1914

Page

Some Economic Aspects of the Present War as Applied to Certain American Chemical Industries.... 55
The Heat Insulating Properties of Commercial Steam Pipe Coverings.... 61
The National Bureau of Standards.... 68
The Engineering-Physics Laboratory of the Bureau of Standards at Pittsburgh.... 73
Some Notes on the Manufacture of Tin Plate and the Recovery of Tin Wastes.... 84
Reinforced Concrete Building in Mexico.... 88
Editorials.... 93
Campus Notes.... 95
Alumni.... 98
Successful Wisconsin Engineers.... 102

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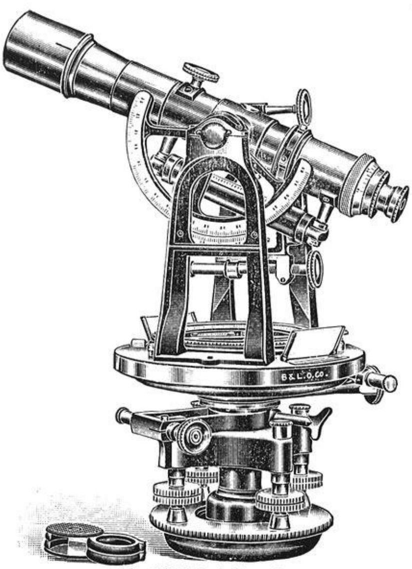

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The Wisconsin Engineer

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SOME ECONOMIC ASPECTS OF THE PRESENT WAR AS APPLIED TO CERTAIN AMERICAN CHEMICAL INDUSTRIES

ALCAN HIRSCH, PH. D. '11.

Consulting Chemical Engineer.

Since the beginning of the European war, as the following figures will show, a considerable number of American industries have been very seriously affected by the cessation of imports from foreign countries, particularly from Germany. The chief industries affected are the textile, chemical, and pharmaceutical industries. We import annually $10,000,000 worth of potash salts, $2,000,000 worth of alizdrin dyes, $7,000,000 worth of miscellaneous coal-tar dyes, $2,000,000 worth of other coal-tar products, neither dyes nor medicines, $4,000,000 worth of ammonium salts, mostly for fertilizers, and a large quantity of fine chemicals, an aggregate of approximately $90,000,000. At the present time, purchasers are clamoring in vain for fine chemicals, drugs, dyestuffs and fertilizers, for all of these goods are considered as almost necessaries.

On the face of it, therefore, there appears to be a most unusual and unique industrial opportunity open to American manufacturers. Our own markets are bare of necessaries, and the markets of Asia, Africa, and South America are clamoring for goods formerly supplied by the belligerent nations. Moreover, the European nations are calling upon foreign trade to supply them with many articles whose manufacture on the continent has ceased. Obviously, the satisfaction of these demands rests largely with the United States.

There is a great obstacle, however, which must be overcome before the industries capable of satisfying the demands can be started in any large way in this country: namely, the uncertainty to which capital thus invested would be subjected. The length of the war is very uncertain, but present indications seem to show that it will not be terminated until one side or the other is thoroughly exhausted.

The length of time necessary for complete exhaustion has been variously estimated at from eighteen months to three years, with a reconstruction period of perhaps two years following the general peace. Consequently, at a conservative estimate, five years from now practically the same competitive situation will face American manufacturers as existed before the beginning of hostilities. It is the fear of the recurrence of this competitive situation which makes the investment of funds in new lines of manufacture in this country so uncertain and which prevents the production here of goods to supply the foreign demand.

A consideration in some detail of the coal-tar dye industry will serve to illustrate the conditions which American competitive industries faced before the war and which manufacturers fear will recur at the end of the war or some few years thereafter.

Our annual importations of coal-tar dyes, chiefly from Germany, amount to about $15,000,000. The whole textile industry depends upon these dyes; and the amount of capital invested in our textile manufacture is nearly two billion dollars. By the cessation of our importations from Germany, approximately 80 per cent. of our synthetic dye is cut off, jeopardizing the entire textile industry. Even should the embargo, as reported, be lifted on dyes, still the stocks on hand are generally small and the factories are closed, and so much relief cannot be effected in any event.

Now the synthetic dye industry is an industry based on the intricate co-operation and inter-dependence of several different industries quite unlike anything that exists in this country. The starting point of all artificial dyes is benzol and its derivatives. These are distillates from tar obtained in the manufacture of coke and in the manufacture of gas. Since all of our coke and practically all of our technical illuminating gas are made from coal, the source of supply of benzol goes back to coal. The United States has vast deposits of coal, and is the greatest producer of coke and gas, but we produce very little benzol. Anyone traveling in Western Pennsylvania or Ohio has doubtless seen the batteries of coke ovens which abound in those iron smelting districts. However, the luminous display, which at night is inspiring to many a layman as an index of American ingenuity and ability, really represents a tremendous waste, for the burning gases contain the valuable ammonia, which is imported to the extent of $4,000,000 annually for manufacture into fertilizer, and benzol, which is the starting product for the synthetic dyes.

By slight changes in our methods of manufacture, we could produce more benzol than any other country in the world. After securing the benzol, in order to produce dyestuffs, various chemical processes are necessary which can be performed economically only by the chemical manufacturer. However, the chemical manufacturer cannot economically and profitably produce dyestuffs alone. He must produce fine chemicals and allied by-products, such as pharmaceutical chemicals. Moreover, the chemical manufacturer in producing these products needs special chemicals. It is obvious, therefore, that the successful production of synthetic dyestuffs requires a highly efficient and intensive co-operative association of chemical manufacturers, gas and coke manufacturers, and manufacturers of fine chemicals and allied products. This involves the bringing together into a close corporation or some such similar combination the chief factories producing these products.

In this country, however, our anti-trust laws, in spirit at least, oppose such combinations. The first essential, therefore, to the manufacture of synthetic dyes in this country, is assurance from our national government that the necessary co-operation and combination between sufficient gas and coke manufacturers to supply benzol and sufficient chemical works to produce the many finished products will not be looked upon with disfavor in official circles.

The second essential is some national protection for this American industry. Foreign methods in competitive trade have been similar to foreign militaristic methods. Foreign manufacturers have always strenuously resisted any attempt on the part of our manufacturers to produce synthetic dyes, and have used objectionable competitive methods to stifle competition from American sources. When small quantities of dyestuffs have been manufactured in this country, foreign dyes have been sold in the American markets for a price equal to and in some cases lower than the cost of manufacture. The foreign manufacturers have had to pay the cost of transportation and the duty in addition to the cost of manufacture, and they they have been willing to face a temporary loss of hundreds of thousands of dollars in order to kill the American product. While carrying on this method of competition, the foreigners naturally marked up prices on dyes not manufactured in this country to compensate for losses on dyes in competition. When competition was stifled, prices on all dyes were raised again and the consumer had to pay the bill for the fight plus a very high price for the dyes.

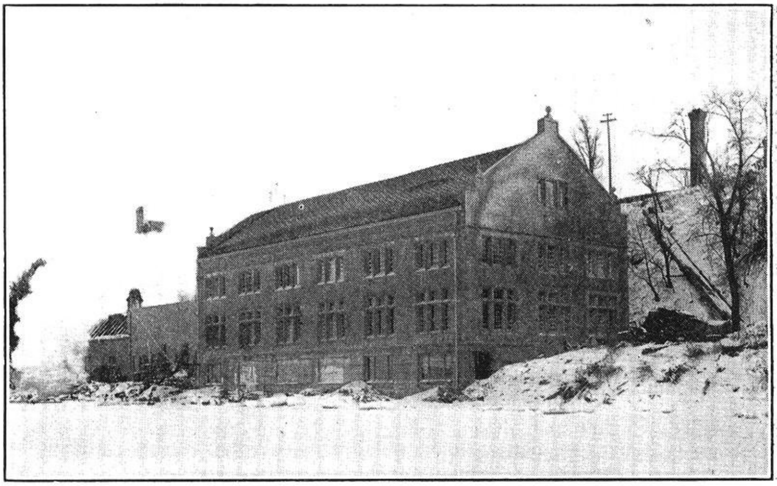
Furthermore, foreign dye manufacturers have for years carried on a systematic propaganda with American textile manufacturers to instill in their minds the idea that dyes can be made better and cheaper abroad than here. Textile manufacturers have been in many cases greatly prejudiced against domestic synthetic dye products and, according to reports, have even been persuaded to influence the government against any protective tariff for this country. The result of this commercial warfare and propaganda is that the prospective manufacturer of dyes rightly feels he must have protection against its recurrence.

The obvious method of protection is a tariff sufficiently high to prevent the stifling of this American industry. The attitude of our government, however, is such that this will not be considered in Washington, even as a war measure. A second method of protection is a contract between the producer of dyestuffs and the consumers. The producer, however, will not consider this suggestion for the reason that he believes that the contract would be broken as soon as foreign dyes were offered at a lower price, with the result that the profits of the business would be consumed in law-suits. A third method is a combination between consumers and possible producers of dyestuffs by means of a connecting corporation, whereby the plants of the possible producers and the money of the consumers are tied up together in the enterprise, thereby assuring the producer that the consumers will not desert him. Obviously the sanction of the administration for this third method is necessary. It is questionable if such sanction can be secured and if such combination can be effected.

What has been said above of the manufacture of dyes, generally applies, in modified form of course, to the manufacture of other chemical products. There are naturally some products which can under no circumstances be produced here, because the starting materials are produced solely by one of the nations at war. Likewise some products can be produced here which were previously neglected because there was no considerable demand in nearby markets. Generally speaking, however, the American manufacture must be allowed so to combine that he can economically manufacture his products, and his market must be protected from foreign competition before he can take the risk of entering into the manufacture of many new chemical products. From the manufacturer's point of view, it would be foolish to invest money in an enterprise in which one can hope to earn only a reasonable return in his investment and in which the capital invested would be jeopardized in the course of a few years.

The present seems to be an excellent time for the Americans to learn how the co-operation of science, finance, and business combined with intellectuality, indefatigability of purpose and energy built up the wonderful industries of Germany, and to understand the underlying causes which over night jeopardized national and international welfare, industry, and commerce. The United States is potentially capable of supplying almost all the chemical needs of her citizens and of producing sufficient surplus chemicals to supply the needs of a considerable part of the world. Our theory, however, has been the theory of world economy, and we have acted on the belief that the products which can be manufactured most efficiently on economic, technical and humanistic grounds in a certain country, where climate, soil and labor conditions are favorable, should be manufactured there and should from there, as far as possible, be supplied to the world. The conflagration of Europe shows how far we are today from the equilibrium of international peace upon which this theory of world economy is predicated.

There is no question that our theory of world economy is the condition we should strive to attain. In the meanwhile, the question is, whether to cling to this theory and allow the demands of a considerable portion of our people and of the people of other countries for necessaries to go unsatisfied now and at the time of every future international quarrel, or whether, keeping our deals, so to modify their practical expression that we will be able to satisfy both our own demands and the demands made upon us.



Hydraulic Laboratory

THE HEAT INSULATING PROPERTIES OF COMMERCIAL STEAM PIPE COVERINGS

THESIS OF L. B. MCMILLAN, M. S. '14, AND H. S. REKERSDRES, B. S. '14.
REVIEWED BY L. B. MCMILLAN,
Instructor in Steam and Gas Engineering.

The necessity for insulating steam pipes against the loss of heat was but little thought of during the earlier days of the use of steam as a medium for the transmission of heat energy. But the advent of higher pressures, superheat, and longer steam lines brought into use miscellaneous materials for the covering of steam pipes. There is now on the market a large number of different kinds of pipe coverings; and the qualities of these should be known, not for the purpose of driving all but one kind out of use, but of aiding the engineer in choosing that which is best suited to the needs of his particular case, for perhaps every covering manufactured has advantages peculiar to itself. When designing a steam power plant or a steam line, the important question for the engineer to ask is: "What commercial covering combines the qualities of durability and cheapness with good heat insulating properties in such a way as to give the greatest net return on the investment?" It was in the attempt to find the answer to this question that the work described in this article was undertaken.

The work of former investigators on this subject would fill many very interesting volumes, but even with the results of these investigations available little reliable data are at hand on the efficiency of steam pipe coverings at the present time. In the thesis of which this is a review, a number of these former works are described, but space does not permit our going into their details.

The general method employed in the tests was to heat a section of covered pipe by means of an electric heater made up of resistance coils inside the pipe, and to calculate the amount of heat lost through the covering by measuring the energy required to hold the outside metal of the pipe at a constant known temperature. It is evident that under constant temperature just enough energy is being supplied to compensate for the losses through the covering. Otherwise the increase or decrease of energy would cause the pipe to heat up or cool off as the case might be. The argument is made that covering tests should be made on pipes actually containing steam in order that operating conditions be obtained. But operating conditions can be duplicated exactly, so far as the covering is concerned, without having steam itself in the pipe; for it can make no possible difference in the rate of heat flow through the covering material whether the heat is from steam or from any other source, so long as the temperature of the outside of the pipe is constant. The phenomenon is one of the flow of heat and there is no condition of heat-flow or of temperature *outside* the pipe that depends on whether it is electrically or steam heated. With a given constant temperature head and a given resistance to heat flow offered by the covering a definite amount of heat will be transmitted regardless of its source.

However, since the temperature considered was that of the outside of the pipe, it was necessary to establish a relation between the temperature of the steam in a pipe and that of the outside metal of the pipe itself. This difference of temperature was measured by means of copper-nickel thermo-couples connected in opposition to each other and to a very sensitive galvanometer in series with the copper leads. One couple was placed directly in the steam and the other was soldered to the outside of the pipe. The deflection of the galvanometer was then proportional to the difference of temperature between the steam and the outside of the pipe. A photograph of this apparatus is shown in Fig. 1, in which half of one section of the covering has been removed to show the location of the couples.

Some trouble was experienced in calibrating the couples accurately for small differences of temperature at high temperatures. This was finally accomplished by placing one couple in boiling aniline and the other in a boiling solution of napthaline in aniline. The difference in the boiling points of these two baths could be increased at will from zero to any desired value within 50° fahr. by adding more napthaline to the variable temperature bath.

Another matter that gave a considerable amount of trouble was that of insulating the wires of the couple that was to be in the steam. This necessitated a steam-tight joint where the wires entered the pipe, and insulation that would be capable of withstanding a steam pressure of 150 lb. per square inch, and

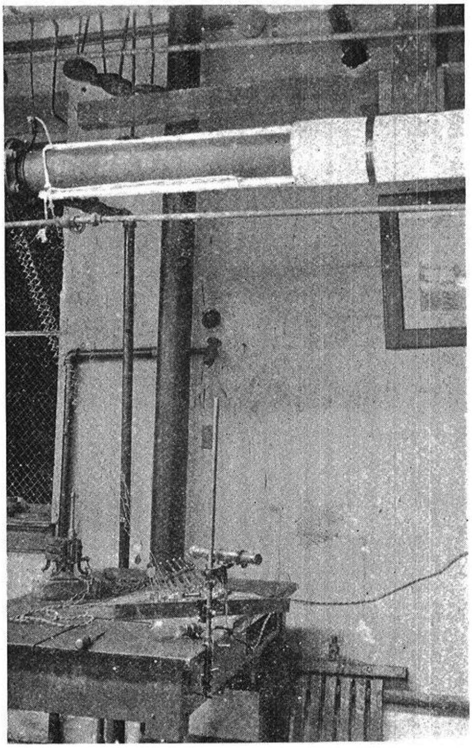


FIG. 1.

that would thoroughly insulate the wires from the pipe and from each other. The arrangement that finally proved to be satisfactory was the following: each wire was placed in a small glass tube, and the whole in turn was placed inside a nipple screwed into a tapped hole in the pipe. The spaces in the latter were then filled with Bakelite, a plastic insulating material that, when baked hard, stands heat and pressure very well. A great many more troubles are recorded in the thesis, for a large part of research work consists in trying things that will not work.

Since it is impossble to give all of them in this review, these two were chosen on account of their great importance with reference to the whole work.

The apparatus for the covering tests is partially shown in Fig. 2. The large pipe, P, contained the electric heater; it was filled with oil which served as a conductor of heat and non-con-

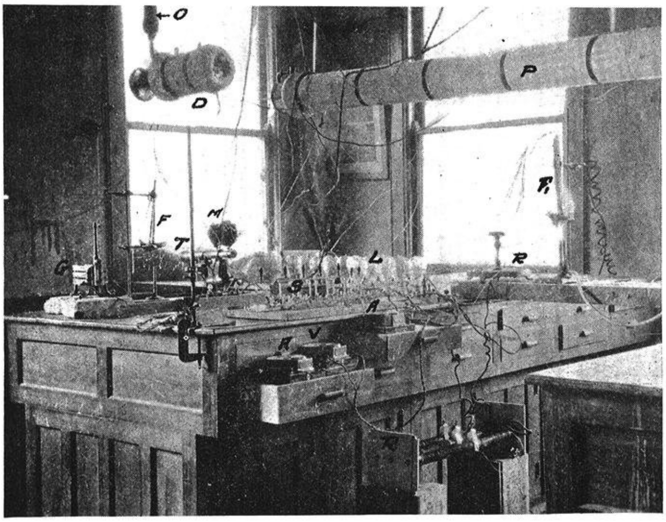


FIG. 2.

M Motor
D-P Pipes
O Pump
F Thermometers
R Rheostats
G Galvanometer
T Telescope
L Lamps
A Ammeters
V Voltmeter
S Switches

ductor of electricity. In order to secure a uniform temperature throughout the pipe the oil was circulated by means of a motor driven propeller. The motor and pulleys on both long and short pipes are shown in Fig. 3. A fifteen-foot section of the long pipe was covered with five standard lengths of commercial covering. This left at each end about five inches, which was covered with eighty-five per cent. magnesia. These short end sections of covering carried the bands by which the pipe was suspended. They had to remain in place durng the entire series of tests, while the fifteen-foot section could be changed without disturbing the rest of the apparatus. The irregular parts of the ends were covered with plastic magnesia.

In order to know definitely how much heat from the long pipe was lost from the ends and how much through the fifteen-foot length of the material being tested, a short section of pipe was made up in exact duplication of the permanently covered ends of the long pipe. This similarity is evident in Fig. 3. If the

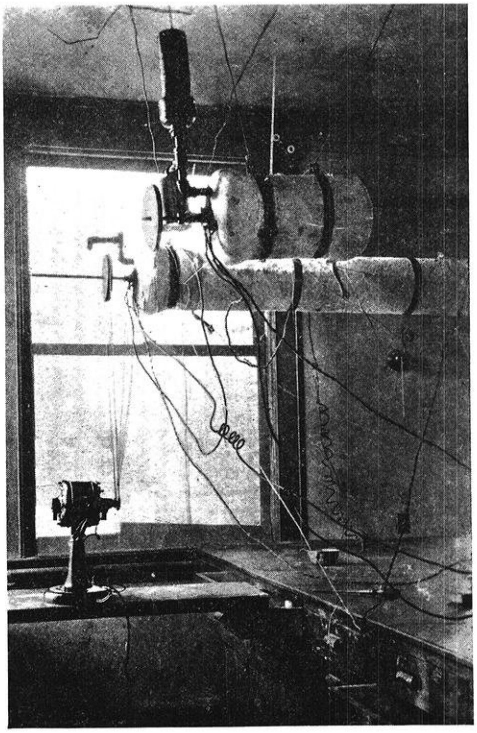


FIG. 3.

fifteen-foot test section were cut out and the ends at the cut sections brought together, the result would be an exact duplicate of the short pipe as far as radiating surface is concerned; therefore the difference between the heat lost in the test pipe and that lost in the short pipe was the exact amount lost from the fifteen-foot section covered with the five standard lengths of commercial covering.

The method of measuring temperatures was in a way unique. Copper-nickel thermo-couples were used and enough of them were distributed along the pipe to make sure of a fair average temperature. The interesting feature was that the cold terminals of the couples were kept within 20° fahr. of the temperature to be measured. This was accomplished in baths of boiling pure substances. Water was used for temperatures near 212° fahr., aniline for those near 370° fahr., naphthaline for those near 340° fahr. and di-phenyl-anine for those near 590° fahr. Tests were made at these four temperatures only. This method [1] necessitated a very sensitive galvanometer by which temperatures could be measured with great accuracy, since the maximum deflection of the galvanometer represented only about 30° fahr.

The manner of conducting the test was the following: The coverings, before being tested for their heat insulating properties, were placed on a pipe containing steam at a pressure of about 130 lb. per square inch and were allowed to dry for a week. At the end of this time they were carefully fitted on a test pipe so that all joints were snug, and were then fastened with staples. Canvas was pasted over the seams, as is done in power plant practice. After the paste had thoroughly dried, the current was turned on the heater coils from 110-volt direct current mains, and was regulated by means of a wound wire rheostat to a value that would hold the temperature of the pipe at some desired value. When this condition had been maintained long enough to make sure that just enough energy was being supplied to make up for the heat losses and no more, readings were taken of voltage, current, and temperatures of the outside of the pipe and the room. From these data was calculated the loss in B. t. u. per degree difference of temperature between pipe and air per square foot per hour.

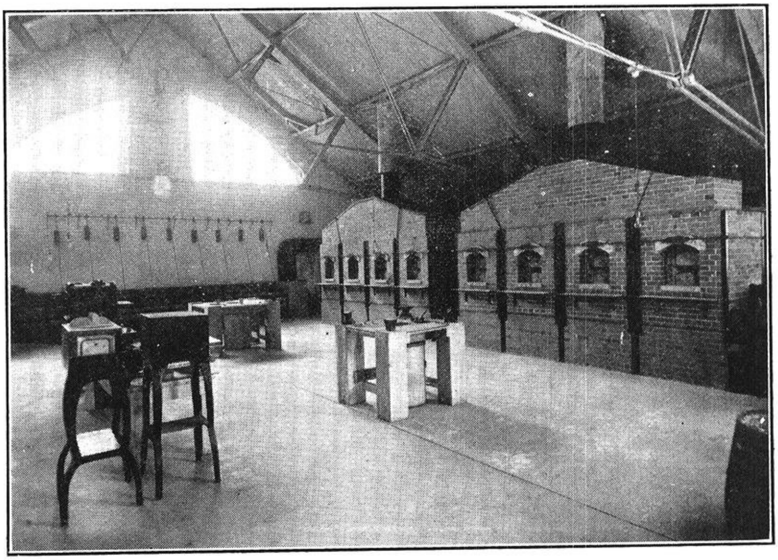
The results of the tests were very gratifying. The accuracy of the method is demonstrated by the fact that duplicate runs gave results that checked, on the average, within one or two per cent., and this is much better than can be obtained from condensation

[1] This arrangement is not being used on the tests now being made, a potentiometer having been substituted on account of the advantages of a zero method of measuring small voltages.

tests. Moreover, the results agree closely with the best work of former investigators, but have the marked advantage that the losses were determined at temperatures ranging from 212° fahr. to 600° fahr. (from the boiling point of water to the region of highly superheated steam), while in former work readings were taken at only one or two temperatures. That such a range of tests was necessary was borne out by the fact that they have shown that the heat lost per degree varies with the temperature.

In behalf of the authors, the reviewer wishes to acknowledge the valuable assistance of Associate Professors A. G. Christie and O. L. Kowalke and Assistant Professors W. Black and J. R. Roebuck, whose advice and suggestions were of the greatest value in this work.

EDITOR'S NOTE.—The December issue of THE WISCONSIN ENGINEER will contain a review of a thesis by Ivan A. Bicklehaupt, '14, on the History of the Telephone.



Mining Laboratory.

THE NATIONAL BUREAU OF STANDARDS

R. G. WALTENBERG, '12.

The National Bureau of Standards was established in 1901 by an act of Congress "for investigation and testing of standards and measuring instruments, and for the determination of physical constants and properties of materials." The main laboratories are situated in the northwestern suburbs of Washington, about four miles from the capitol, in a location comparatively free from mechanical and electrical disturbances. At present there is a group of five buildings, which with the well kept lawn, old trees, pure air, and the quiet of the country causes the bureau to resemble more than anything else a modern college with its campus.

Standards may once have been restricted to length, area, volume, and weight, but now we must include measures of power, electric current, heat, light, and physical properties, such as tensile strength and hardness. Almost every industry has its units and methods of measuring and it is necessary for this bureau to standardize measuring instruments so that measurements made on a material in one place may be duplicated in another with the same results. An important part of the work is the research in various lines conducted to improve standards and methods of measurement. According to the problem which they represent standards may be divided into four classes:

1. MEASUREMENT

This class includes, among others, such primary standards as length, mass, and capacity.

2. VALUES, OR PHYSICAL CONSTANTS

Under this head may be classed the determination or redetermination with improved apparatus of constants of interest to scientific and technical men.

3. QUALITY

Preparation of specifications and determination of properties upon which the quality of various materials depend.

4. PERFORMANCE

Comparison and testing of apparatus and instruments.

It has not been the policy of this bureau to adopt arbitrarily technical standards, but when those interested agree as to the best standards in any particular case, the bureau will undertake to determine whether the articles submitted conform to the standards agreed upon. The bureau co-operates to the fullest extent possible with all movements tending to improve conditions in which standards of quality or measurement are involved and it always aims to advance industry by the application of science and scientific research to commercial processes.

About 350 persons are employed by the bureau; about 275 of these are scientific and technical men, the remainder are clerks and mechanics. The personnel is organized into divisions which do correspond not to the classes of standards, but more nearly to branches of science. The divisions at present are:

1, Electricity; 2, Weights and Measures; 3, Heat and Thermometry; 4, Optics; 5, Chemistry; 6, Engineering Instruments; 7, Structural Materials; 8, Metallurgy.

New divisions are formed as the work in any branch increases, and the advisability of a closer organization in that branch becomes apparent. The names of the divisions give some indication of the nature of the work undertaken by that division.

The work done by the Bureau of Standards can be divided into two parts, that done for the public and that for the government. The bureau makes no attempt to compete with private commercial institutions, and in a majority of cases the tests or experiments represent a class of work which it is possible to do nowhere else, or requires a degree of accuracy obtainable only with the apparatus of the bureau.

The establishment and maintenance of fundamental electrical units in co-operation with other national laboratories is of great scientific and technical interest. Much work on specifications for the voltameter was carried out at this bureau by the representatives of the national laboratories of England, Germany, France, and America, in order to obtain and adopt an international value for the Weston normal cell used in practice to define the international volt. In a similar manner the bureau has co-operated with other laboratories in the determination of units of resistance and current. The testing and comparison of electric measuring instruments used by electrical engineers is another branch of prime importance to technical men. Many classes of instruments are tested and the different types are investigated and compared. Of interest to engineers are tests made both in the laboratory and under actual working conditions on the electrolysis of gas and water pipes and other subsurface structures by stray electric currents in the earth. In co-operation with gas companies and public service commissions the gas investigations have done much to improve and regulate gas service to the advantage of the consumer and the gas industry.

The Bureau of Standards has prototypes of the international metre and kilogram. From these standards are derived all other units of length and mass, including the yard, pound avoirdupois, and pound troy. An accurate measure of length is evidently necessary in any construction or engineering work. The bureau tests many devices, such as gauges, bars, rules, tapes, and level rods. These are standardized under definite conditions of temperature and support to an accuracy depending on their use. Calibration of a surveyor's tape is usually made to 0.02 in., or one part in 60,000, while special calibrations for the coast and geodetic survey may be to one part in 2,000,000. In the weights and measures divison investigations are in progress on expansion of materials over a considerable range in temperature, and on aneroid barometers suitable for explorers and aviators. A specially designed and constructed test car for testing and investigating railroad track scales is making trips over the country.

The establishment and maintenance of a standard scale of temperature available for the public for reference has been the aim of one section of the bureau. The national laboratories of England, Germany, France, and America have been progressing in negotiations with the view of an international agreement on a standard temperature scale. The testing and calibration of mercurial thermometers and pyrometers has done much to reduce the uncertainty in the temperature measurements of commercial processes with the consequent improvement of the products. An idea of the amount of such work may be gained when it is stated that the bureau tested over 15,000 clinical thermometers last year. The work on calorimetry is important because of the progress made towards bringing fuel value testing to a uniform basis throughout the country, and thus reducing the number of disputes between buyer and seller of fuels owing to different results of tests in different laboratories. The investigation of refrigeration constants now being undertaken is of special interest to engineers. The latent heats, specific volumes, vapor pressures, densities, and other constants for water, ammonia, carbon dioxide, and methyl chloride are being determined.

Tests are made on telescopes, microscopes, photo-lens, and other optical instruments. They show that purchasers of photographic lenses do not always get the aperture ratio they expect. Of the same nature is the investigation of resolving power of many photographic plates. Polarimetric apparatus is used extensively in the testing of sugar, and this bureau has been supervising the work of the treasury department customs laboratories with the result that systematic differences existing between various ports of entry have been reduced.

The work of the chemistry division extends to all sections of the bureau. Few investigations do not need expert chemical advice or a chemical analysis. Besides the research for new and improved methods of analysis this division prepares analyzed standard samples by means of which a check can be had on the methods of any laboratory.

Engineering instruments tested by the bureau include water-current meters, anemometers, speedometers, taximeters, pressure gauges, water meters, gas meters, and steam engine indicators. A 400-foot testing tank for rating current meters has been constructed to provide facilities for investigating the characteristics of these instruments. Various makes of steam radiator valves are being compared at the request of the treasury department.

The bureau is well equipped with machines for testing engineering, structural, and miscellaneous materials. Two large testing machines, an Emery machine having a capacity of 2,300,000 pounds in Washington, and an Olsen of 10,000,000 pounds at the Pittsburgh laboratory, are used continuously on large columns in a series of tests to correct formulae used by engineers for computing column strength, upon which the safety of bridges and buildings depends. In conjunction with laboratory tests strain measurements have been taken on buildings and bridges in use and in construction to determine the behavior of structural material in service. These measurements have included the Panama Canal locks, hulls of ships at sea, and some of the tallest buildings in New York. The laboratory does much work on rubber, textiles, paper, clay products, and cement, and cooperates with other government departments and the technical societies in a number of investigations on miscellaneous materials and in developing specifications and methods of testing.

The metallurgical division has tested and made thermal and microscopic studies of a number of steel rails from representative rail mills in an effort to determine factors in the manufacture which tend to give poor rails. A study of the critical ranges in pure iron and a number of pure iron-carbon alloys is being made. This division is also determining the melting point and emissivities of a number of refractory elements and oxides.

The laboratories of the bureau are always open to technical men and others who desire information on methods or results, or who desire to inspect the bureau's equipment. Information is distributed through correspondence and publications. The publications of the Bureau of Standards contain the results of its work on standards, instruments, constants, and methods of testing, together with legislation, specifications, and other information of general interest. The papers are issued in the form of scientific, technologic, and miscellaneous papers and circulars, for distribution on request. The technical library of the bureau contains over 10,000 volumes and receives current numbers of about 325 periodicals. The easy access to literature on any subject is a great advantage in technical and scientific investigations.

The excellent facilities available for tests, the advice of experts in any field, and means for designing and constructing new apparatus in a well equipped instrument shop with skilled mechanicians, have been large factors in placing the results of the Bureau of Standards upon the high plane they occupy.

THE ENGINEERING-PHYSICS LABORATORY OF THE BUREAU OF STANDARDS AT PITTSBURGH

J. H. Griffith, '93.

The Bureau of Standards, of the Department of Commerce, in addition to its extensive laboratories at Washington, maintains several departments at Pittsburgh for scientific investigation of commercial and engineering problems. In the latter are comprised five divisions: a clay products laboratory, devoted to the needs of the ceramic industries; a cement laboratory for the investigation of cement in its course of manufacture from the kiln to the finished product; a laboratory for the investigation of fire-proofing problems; a section for the study and experimentation in limes; and an engineering-physics division which is mainly engaged in the work of research in the materials of engineering construction. While these laboratories are not at all limited in their scientific scope and aims, they seek to be of practical utility in promoting progress in both the manufacturing industries and engineering sciences. The administration of the laboratories is under the general supervision of an executive head, who represents the Dirctor of the Bureau at Washington, there being in addition division chiefs in technical charge of each of the sections. The present paper will confine itself to a brief description of the engineering-physics laboratory, its work, future programs of research and scientific aims, because these are of particular interest either to those who are just making a start in the engineering profession, or to those already engaged in its practice.

DESCRIPTION OF LABORATORY

The engineering-physics laboratory proper consists of a main building of steel skeleton framework, with reinforced concrete side walls and roof, with a floor area of 94 by 41 ft. The structure is lighted from four tiers of windows on three sides. In addition there are offices, a well equipped machine shop for construction of apparatus, a carpenter shop, and store rooms. The building is connected with the other laboratories, as mentioned above. Adjoining the rear of the laboratory are track facilities and a storage yard with crane runway. A 30 ton crane, electrically operated, traverses the yard and entire length of the building, passing from the building to the yard through a system of vertical and horizontal operating doors. Thus a heavy steel specimen can be removed from railroad cars and carried to the proper testing machine with a minimum of time and effort.

The crane clearance necessitates an unobstructed height of some 60 ft. to the roof of the building. In view of the large lateral wind pressure due to this great exposure, as well as to crane thrust and considerable thrusts from the heads of the larger vertical testing machines, it was thought best to provide a trussing for the supporting columns on the exterior of the building. This is in accord with standard engineering specifications. Such trussing insures a fair degree of stability in case of strong winds, a runaway crane, or the accidental dropping of a heavy column or other specimen against the side walls during the operation of a testing machine. The building and its foundations are believed to be of ample strength and stability for the requirements of a laboratory to be used for tests of full size engineering specimens.

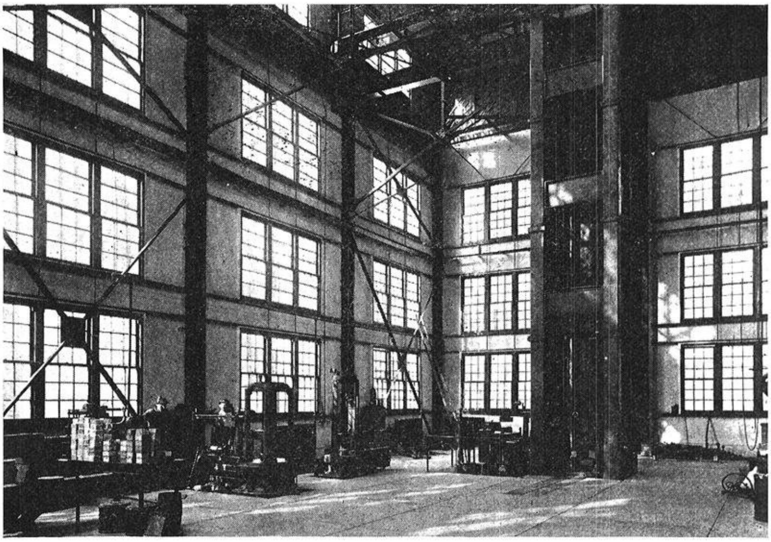
EQUIPMENT

An interior view of the laboratory showing at one end the crane doors through which the crane may pass to the yard is given in Fig. 1. The cut gives a fair idea of the testing machine equipment of the building. In addition to a series of small machines, there are several testing machines with capacities ranging from 100,000 lb. to 200,000 lb., which are used for such general routine tests supplementary to those of the several laboratories as become necessary; for outside commercial tests; and for acceptance tests of materials, to conform with the specifications of different departments of the government.

The large vertical machine shown at the end of the building in Fig. 1 is a screw machine of the Olsen type, having a capacity of 600,000 lb. It is capable of testing to destruction in compression a specimen 30 ft. long, or in tension one 24 ft. long with a 25 per cent. allowance for elongation during the test.

Upon the extension platforms shown level with the floor it is possible to make tranverse tests of beams or girders up to 25 ft. in length under a maximum center load not exceeding 200,000 lb.

There is sufficient open floor space around all the testing machines to permit ready access to the gears and operating machinery; in these spaces are openings to an ample corridor or



Interior of Testing Laboratory, Bureau of Standards, Pittsburgh.

tunnel which leads to the various machines, and also serves as a conduit for a lower tier of pipes of the low pressure heating system and electric wiring. It also serves as storage space for heavy parts of machines which are only occasionally brought into use in certain tests.

THE 10,000,000 POUND COMPRESSION MACHINE

At the opposite end of the building, Fig. 2, the entire floor space is taken up with the 10,000,000 lb. compression machine and its weighing mechanism. This machine, which was designed by Mr. Tinius Olsen, has been in use since the opening of the laboratory for operation—a period of over two years. Since this machine has been perhaps of greatest interest to enginers and manufacturers visiting the laboratory, a short description will be given of its main details and its operation.

The machine as originally designed was capable of taking a specimen 65 ft. long and 6 ft. square under a compression load of 10,000,000 lb. It has indeed been tested by a proof load to considerably over this maximum. In the design of the laboratory, however, it was deemed expedient to use only the lower set of straining screws, and so the machine was constructed with a length capacity of 25 ft., which is adequate, since the greater number of specimens tested do not exceed 10 to 16 ft. in length. In the design of the building, arrangements were made by the designer for the possible future extension to the original length capacity, as called for in the original design of the machine.

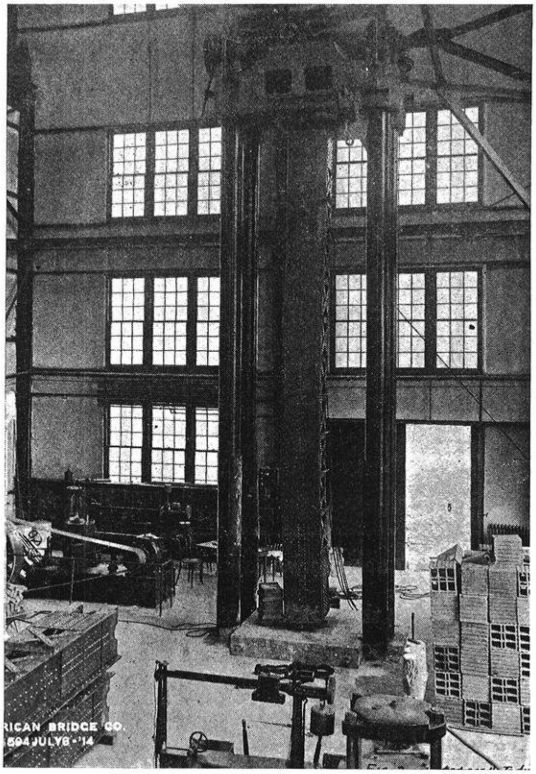


FIG. 2. *10,000,000 lb. Testing Machine.*

The upper screws were stored in a housing adjoining the laboratory, so that if occasion called for it, the whole length of the machine could be used without great additional expense or change in the building, excepting an adequate lateral supporting frame to the machine.

In its structural features the 10,000,000 lb. machine is not very different from the 600,000 lb. machine of the University of Wisconsin laboratory. Both use the principle of the hydrostatic press. Oil is pumped by means of a triple plunger pump from a reservoir below the weighing apparatus, Fig. 2, to the 50 in. diameter cylinder of the testing machine, and simultaneously to a smaller cylinder having a piston 5.6 in. in diameter. The latter connects directly with the weighing levers, so that one-eightieth of the load on the testing machine is weighed. By a system of gate and needle valves, together with a controller, it is possible to obtain upward speeds of the larger cylinder from the minimum up to about a half an inch per minute. The total stroke of the piston is two feet.

In addition to the testing machine, the laboratory is equipped with smaller apparatus, like extensometers, etc., which is added to yearly according to the needs of growth. It is the policy to construct most of the apparatus in the machine shop as required from time to time in the different tests; and so a skilled mechanician and a corps of machinists for supplying the requirements of this and the various other laboratories are maintained.

ROUTINE OF TESTS

In addition to its formal programs of research, the laboratory has in the past three years made numerous commercial tests covering a wide range, such as tests of concrete and steel columns, brick piers, car couplers, tile, coke, chains, rope and cables. It has also conducted, in co-operation with the American Concrete Institute and Professor A. N. Talbot of the University of Illinois, probably the most systematic investigation yet made upon reinforced concrete columns. One of these columns after test is shown at the left of Fig. 2. In co-operation with the U. S. Bureau of Mines and the Mine Cave Commission of the State of Pennsylvania, it has made very detailed experiments to ascertain the most effective forms of construction and material to be used in preventing the subsidence of the earth surface owing to removal of coal or ore in mines.

Upon request of the New York Connecting Railway, through Mr. Gustav Lindenthal, its chief engineer, there has also been made a study upon steel columns to ascertain the effects and extent of initial strains incident to manufacture. A large number of cables and full size rope specimens have been tested from time to time for the Isthmian Canal Commission, to determine the quality and suitability of this material in the construction of the Panama Canal.

SCIENTIFIC PROGRAMS IN RESEARCH

During the past two years the laboratory has been engaged in the study and formulation of several programs of research in the various departments of engineering science. It has been the general policy to make such investigations as detailed and exhaustive as possible, in response to past criticisms (such, for example, as those of Rear Admiral Melville, U. S. N.) that certion of the engineering experimentation in America and England has been of a somewhat sporadic character, and that particular aspects and behavior of small specimens have been too often studied rather than the general laws of action of specimens of a size somewhat commensurate with the needs of engineering practice.

In arranging these programs, the limitations and adaptability of the laboratory have been taken into account. All the machines are of the screw vertical type having an accuracy of approximately one per cent. The more precise machines of the bureau located at Washington, D. C. are of the horizontal Emery type and have a peculiar field of experimentation of their own, where particular refinement is necessary in the results or where a horizontal machine can be used to greater advantage than a vertical machine. The smaller test columns now being investigated in co-operation with the American Society of Civil Engineers Committee are being tested at the latter laboratory.

The problems of research which are being commenced or have already been in progress for some time at Pittsburgh include the investigation of large bridge columns, brick piers, tile, cables and the physical properties of earths. The aims of the research and methods of investigation will be briefly outlined.

TEST ON LARGE STEEL COLUMNS

In collaboration with prominent consulting engineers and manufacturers it has been possible to make an extensive investigation of the stress and strain behavior of large steel columns corresponding to actual members of some of the long span railroad bridges now being erected in America. The specimens represent the highest type of modern design. Comparative effects are noted in the use of different grades of steel, as to their efficiency for column construction. Thus far the columns tested have been constructed of nickel, chromium, silicon, Mayari (Cuban) and high carbon steels. In long span bridges the reduction of the weight in trusses by the use of suitable high grade steels is of paramount importance. It has been possible to detect sometimes during tests certain weaknesses of design, unforeseen by the designer, so that before the actual construction of the bridge the column details may be suitably modified better to fulfill the purpose of the engineer.

In the investigation, one procedure has been usually followed, that of seeking first the unit behavior of the column, just as if it were a small test piece, and then making as many measurements as the time available for tests will permit in order to study in detail deflections and sets in steel and the behavior of lattice and pin plate.

There are two methods of approach to a study of mechanics of the column. Most engineers are constrained, probably by force of circumstances, to a somewhat academic point of view, which premises a homogeneous isotropic steel free from initial strains and very uniform in elastic properties. They then attempt from *a priori* mathematical considerations to design the most efficient type of column for the bridge. On the other hand, the testing engineer discovers rather a wide divergence from a perfectly elastic material, so that he must abandon many of his earlier notions of the higher mechanics of column action and more largely confine his attention to a careful study of strain phenomena. Even in the same heat of metal it has sometimes been noticed that separate small test pieces show a very wide difference of range in their elastic limits or ultimate strengths of the component steel. For instance, when a specification calls for 60,000 lb. per square inch maximum stress, the actual values from tests may run from 57,000 to 63,000 or 64,000 lb., and correspondingly for the elastic limits. Causes of departure from the perfect elastic medium are due to initial strains from unequal cooling, or subsequent strains induced through straightening of shapes, punching and riveting.

The relatively complex "matter" of the member, composed as it is of steel shapes under degrees of initial strain varying to such an extent as would be impossible to state or to define mechanically, is made to play a much simpler role by tests on the elastic behavior of the column as a whole, as previously mentioned. The complicated structure is ignored altogeher in the action of the column as a unit and the conceptual medium substituted whose properties are to be determined. Of course the variations in structure are carefully noted, but they are differentiated from the other. Accordingly, it is possible to draw a stress strain curve and other characteristic curves in which moduli, elastic limits, maximum and ultimate stresses are found just as for a small test specimen. The designing engineer recognizes that these coefficients are for the composite structure and not for the particular steel, although there is a definite correspondence to be found between the two sets. The engineer then finds that he may use his elastic limit as a sort of critical point which the totality of such working stresses as dead load, live load, wind, and impact, appropriately combined, shall not exceed, much as in the earlier cases of designing, where homogeneity of the steel structure has been assumed.

While such considerations as have been given have made necessary certain modifications in the refined theories heretofore elaborated by engineers, based as they have been upon insufficient data and from deductions drawn from small column pieces, it is hoped by the present investigators to establish a unique if not precise working formula fcr the column, or at least to set certain definite limits between which the range of variation in functions may be expected to occur, and upon which the consulting engineer may feel some degree of confidence in perfecting his design.

TESTS ON BRICK PIERS

Departures from the accepted norms of standard practice become evident in brick piers even more than in steel columns, be-

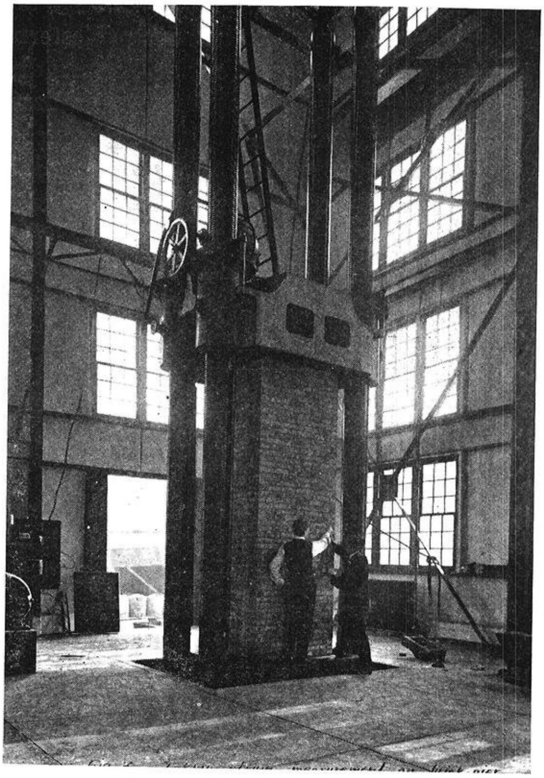


FIG. 3. *Taking Strain Measurements on Brick Pier.*

cause account must be taken of a greater range in the qualities of material, geographic location of the manufacturer, manner of laying brick, and similar variables, in addition to the time variable, due to the greater strain variations on the mortar over that of the brick during the time of tests.

With the co-operation of the National Brick Manufacturers

Committee of Investigation, consisting of Professor E. A. Orton, chairman, and Professor A. V. Bleininger of the bureau, the laboratory is making a careful series of tests on brick piers, of an average size of 30 in. square by 10 ft. high. Fig. 3 shows a view of a brick pier 4.0 ft. square during test. In the arrangement of the tests the brick have been selected from four geographical centers which are fairly representative of the type of fabrication east of the Mississippi. These are the Chicago and western district; the Pittsburgh district, including Western Pennsylvania and Eastern Ohio; the New York or Eastern district; and the Southern district, including southern manufacturies from Birmingham to New Orleans. Other variables which enter into the investigation are the quality of the brick, which is defined by the several tentative specifications of the American Society for Testing Materials, the manner of laying, and the grade of mortar, together with numerous minor variables.

By its tendency continually to fall without the domain of the elastic, through such influences as, for example, the viscosity in mortars, the action of brick under stress affords a wide field for detailed investigation in the engineering laboratory.

TESTS ON TILE

An extensive program of tile testing has been arranged through the valuable aid of Professor A. V. Bleininger of the Clay Products Division, and in consultation with the Manufacturers and Industrial Commission of Wisconsin, for the purpose of precisely determining the elastic properties of individual tile, as well as that built up in walls, columns and floors. The fire-proofing laboratory will also probably co-operate in this field.

TESTS ON CABLES

The mechanical analysis of a single strand of a cable, subject, as it usually is, to peripheral friction, torsion, bending and longitudinal stresses, affords a problem which is perhaps more general in its scope than the problems in other fields of investigation. In addition to the purely mechanical features, there are also presented the problems of the chemistry and metallography of the component steel, the action of internal lubrication, quality of rope core, and many others. The bureau will conduct this investigation, taking into account the many variables, and through the data seek to establish not only the general laws of cable action, but also to provide adequate data for properly formulating engineering specifications.

STUDIES IN THE PHYSICS OF SOILS

Apart from chemical, mineralogical, bacteriological, and general agricultural phases of the study of soils, there is a purely physical aspect which is important to the engineer, such as is incidental to the problems of design of arches, culverts, retaining walls, and to the question of bearing power of piles and foundations. In co-operation with the committee of the American Society of Civil Engineers, Mr. R. A. Cummings, chairman, the laboratory will attempt to determine to what extent a purely physical classification of soils is possible, and also endeavor to bring the subject as far as practicable within the domains of the department of the testing of materials. Since an earth is intermediate in its elastic properties between the perfect fluid and the elastic solid, possessing analytically the nature of a viscous medium, the laboratory will endeavor to ascertain such factors as pressure-volume relations, critical points at which internal friction of particles restrain motion against gravity and other forces, the law of diminution of shearing stress with distance from immersed body, the ratio of the lateral to normal pressure, coefficients of friction, Poisson's ratio, and others, together with certain laws in the dynamics of pulverulent media. The effect of the size of particles, physical constitution of grains, cohesive action, and moisture content will be studied, in relation to the distribution and variation of stress, and the results of investigations applied directly to determining the laws of bearing values of piles, foundation and retaining walls. In the problems pertaining to such structures, perhaps the chief departure that will be made from many of the earlier investigations is that more attention will be given to determining the laws of variations of the several coefficients considered as point functions, and the laws of the resultant pressures; and to finding engineering application after these laws have been determined, whereas it has been the general practice to ascertain only the resultant action of the earth on the body.

SOME NOTES ON THE MANUFACTURE OF TIN PLATE AND THE RECOVERY OF TIN WASTES

O. L. KOWALKE.

Associate Professor of Chemical Engineering.

As early as 1620 [1] the trade of making tin plate had existed for many years in Bohemia and about this time it was introduced into Saxony, Germany. In 1670 the secret of manufacture was carried to England, but it was not until 1720 that the industry was firmly established. Soon after the art was introduced into England it began to flourish because of the excellent deposits of tin in Cornwall. It was not until about 1890 that the tin plate industry in the United States assumed any importance. Under the stimulus of the protective tariff a number of large plants were built, which, by the application of machinery and shop management, were able to produce more than enough for home consumption. The supply of tin must, however, be obtained largely from abroad and this has led to numerous processes for the recovery of tin from tin scrap.

Tin plate consists of a thin sheet of iron or steel coated with tin. The thickness of this coating depends on the uses of the product; tin plate for toys, fruit and meat cans has only a very thin coating, while the material used for milk cans has a thick coating. Roofing tin plate is frequently made by coating the iron sheet with an alloy of tin and lead in the proportions of one of tin to three of lead. Such an alloy of tin and lead will not rust so easily as pure tin.

Unlike iron, tin is not oxidized easily nor is it affected by moisture; hence if iron can be protected by such a coating it will resist rusting for a long time. If, however, the iron is imperfectly coated or if a scratch develops, the contact of moisture with the tin and iron produces a galvanic couple in which the tin is the cathode and the iron the anode and by which rapid rusting results. It is frequently noticed that tin pails or cans rust in round spots. Since this means that there is a minute point of iron which has not been covered with tin it is

[1] History of Trade in Tin, by C. W. Flower, p. 37.

imperative to have a smooth and perfect covering of tin over the iron. An alloy of tin and lead makes a better covering and does not exert such a strong galvanic action.

The iron or steel from which the plate is rolled is a bar about 8 in. wide and 0.25 to 0.75 in. thick. The heated bar is rolled into sheets perpendicular to the direction in which the original bar was rolled. Assume that sheets 20 by 28 in. are desired. The original bar is given singly five passes in the rolls until it is a sheet 28 in. long. Two such sheets are heated again and rolled, superimposed one on the other, until their length is 56 in. During each rolling the sheets are pulled apart so that the formation of a scale is promoted and sticking prevented. The two sheets are folded to make four thicknesses and after being heated are rolled out again to a length of about 54 in. These four thicknesses folded again to make eight are heated and rolled until the length is about 56 in. After the eight rolled sheets are cut and squared into small sheets 20 by 28 in. they are ready for the pickling.

The packs of eight sheets 20 by 28 in. are opened so that they do not adhere to one another and are piled on carriers, which move up and down in a pickling bath of hot eight per cent. sulphuric acid for about ten minutes. This pickling removes all the scale and leaves the iron bright and clear. After removal from the acid the plates are washed in clear water to free them from acid. For further particulars regarding pickling methods the reader is referred to an article by Mr. O. W. Story in Met. & Chem. Eng. Vol. X, p. 45 (1913).

To remove the stains set up by the rolling the washed sheets or plates are packed in annealing stands, carefully covered to exclude air, placed in a furnace and annealed at 1,500 degrees fahr. for twelve to eighteen hours. They are allowed to cool slowly away from contact with air. When cold the annealed sheets are cold rolled singly between polished rolls to give them a smooth surface and close any pores. Two or three passes are usually sufficient. After being rolled they are packed in cases away from air and again annealed for five or six hours at 1,200 degrees fahr. After the second annealing the plates are again pickled in a weak sulphuric acid solution to remove the last scale and are washed in clean water. To guard against rusting they are put into tanks of water and carried to the tinning house.

The tinning bath consists of an iron box, the lower half of which contains the molten tin, and the upper half of which is divided into two compartments by a partition which dips into the molten tin. Floating over the molten tin in one of these compartments is a fluxing solution, usually zinc chloride; in the other is palm oil. At the surface of the molten tin in the palm oil compartment is a pair of rolls. The iron sheets are taken from the water, passed into the fluxing bath in the first compartment, thence down through the tin, caught by the rolls and brought out through the palm oil in the second compartment. The rolls are so set that they not only draw the plates out of the bath, but they also press off any surplus tin and leave the plates somoth. The palm oil is intended to keep the plates bright and protect them from the moisture in the air during storage. The plates are now put into a machine which takes off the surplus oil by bran and lime. From this point the plates go to the sorting room where they are closely inspected and packed. At all points of the process close watch must be kept. Since each sheet must be handled, it can readily be seen that the cost of tin plate is high.

Excellent articles on tin plate manufacture will be found in Scientific American of Oct. 4 and Nov. 1, 1902, and in Metal Worker of Feb. 14, 1903, and July 21, 1905.

Owing to the limited supply of tin ores and metal much attention has been given to the recovery of tin from waste. In the process of coating iron sheets with tin a waste material called dross is obtained from the bath. Various methods are used for recovering the tin from dross. Among them is that devised by R. S. Wile,[2] by which the tin dross is reduced in the electric furnace by being fed with a carbon charge into a molten bath of inert slag having a lower specific gravity than tin. The reduced tin falls through the slag to the bottom of the bath, where it can be tapped off. Any metal which is vol-

[2] Met. & Chem. Eng. Vol. XIII, 1910, p. 151. Trans. Am. Electrochem. Soc. Vol. XVIII, 1910, p. 205.

atilized is caught by the charge of dross and carbon. Thus the loss of tin is kept down to less than one per cent. In his furnace with an energy consumption of 88 kw Wile has reduced about 2,500 lb. of dross per day.

Tin cans and tin scrap also are worked over to recover the tin. For this purpose the electrolytic and the chlorine detinning processes are in use. The former is more expensive than the latter, which seems to be gaining considerable ground in this country.

The chlorine or Goldschmidt process [3] is based on the fact that dry chlorine does not attack iron, but only the tin, forming tin tetrachloride. The tin scrap compressed into bundles is put into a chamber and dry chlorine gas admitted under several atmospheres pressure so that the gas gets into every crevice. On account of the heat developed due to the action of chlorine on tin during the stripping, great care must be exercised. When the gaseous chlorine forms liquid tin tetrachloride the pressure drops, and as long as the pressure continues to drop detinning takes place. When the pressure becomes constant it is evident that the chlorine has found all the tin. The tin tetrachloride thus recovered is greatly prized by silk dyers for use as a mordant.[4] The value of tin tetrachloride is about $0.14 per lb. of 50 degrees Beaume strength. The iron remaining after washing can be used in open hearth processes for making steel.

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[3] Met. & Chem. Eng. Vol. VII, 1909, p. 80.

[4] Met. Chem. Eng. Vol. VI, 1908, p. 150.

REINFORCED CONCRETE BUILDING IN MEXICO

J. F. Abbey.

From the contractor's point of view, reinforced concrete building in the Republic of Mexico is in its infancy, for it is only within the past five years that concrete building has made any great strides as compared with other classes of building in the country. The few concrete buildings that have already been erected have been less expensive than any other class of structure. From every point of view the results to the owners have been not merely satisfactory, but gratifying. Due to the uniformly hot weather which prevails in the greater portion of the country, the first important requisite of a building is imperviousness to heat. In this respect concrete structures have proved equal to the very adaptable and therefore universally popular adobe building. There are only four or five contractors in the entire republic engaged in this particular line of work, hence the field is practically untouched, a condition that must appeal to the young engineer.

It seems especially worth while to consider the conditions the contractor will encounter in entering the field.

As heretofore intimated, the adobe building predominates in the greater portion of the country. This type of construction consists of blocks of ordinary clay, which after being mixed with a little straw is baked in the sun until it becomes sufficiently hard to be handled. Since these blocks are made in moulds 3 by 10 by 14 in. they give a minimum wall thickness of 10 in.; but in many cases two and three blocks are used, so that two and three foot walls are common. The mortar used to set these blocks is made from the same clay, and the building is finished off with ordinary lime plaster, some of which is smooth, some rough cast and decorated with gay designs and colors.

Besides adobe, brick, stone and structural steel are used extensively. The brick is of rather poor quality, and does not come up to the poorest common brick made in the United States. Sand lime brick is used to some extent in the northern part of the republic. Faced brick is neither made nor used in the country. Stone is used mostly for the foundation and occasionally for the superstructure, but its use varies in different parts of the country. Structural steel is used only in the larger buildings, such as factories, warehouses, and the like. The steel is rather expensive, since there is only one foundry in the country. The majority of the heavy structural steel is imported from Belgium, and the rest from the United States. Regardless of the material used, the style is practically the same for all buildings. Especially is this true of residences, which are usually one story in height.

Ten years ago the greatest portion of the cement used was imported, and most of this came from Germany. Since then two cement factories have been built, one in the northern part of the republic and one in the southern part. These two factories now supply about ninety per cent. of the cement used. This product is equal to our best brands and passes the tests of both the American and European Societies for Testing Materials. The price of cement at the present time is $4.00 per barrel. It is put up in cloth or jute sacks weighing 95 lb. and 50 kg. respectively. One company sells its product by the barrel and the other by the metric ton.

The steel used for reinforcement is made in the republic. The types of bars made are: the Johnson corrugated, the square twisted and the plain round. The price averages about $75.00 per metric ton.

For lumber in the form work, both the native product and that imported from the southern part of the United States are used. While the native lumber is cheaper, the southern yellow and white pines are far superior in both quality and strength. Imported lumber costs from $30.00 to $40.00 per thousand board feet, while the native is about $5.00 cheaper.

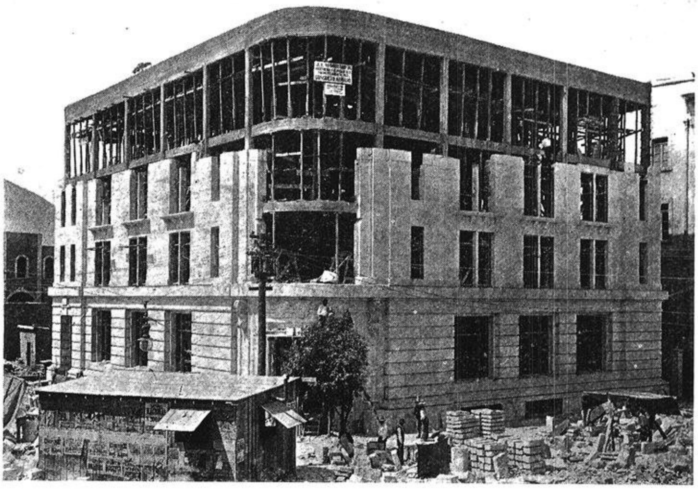
Both gravel and crushed stone are used in the concrete work. The quality of both is good. Due to the lack of quarries and crushers, gravel is more extensively used than stone. This is the river gravel, well screened and well graded. Its price averages about $1.00 per cubic metre, while the stone is usually delivered in carload lots, selling at from two to three dollars per metric ton. Good coarse sand is scarce in the country. All that is available is rather fine, but free from loam or foreign vegetable matter. On some parts of the coast a good clean coarse sea sand is abundant. One may expect to pay about $0.75 per cubic metre for his sand.

All machinery and other plant equipment for building purposes has to be imported, since none is manufactured in Mexico. The majority of this material, especially of the higher grade, comes from the United States; and since the duty is usually high, one can count on it costing twenty per cent. more than in the States. Aside from the materials actually used in the concrete work, the other materials required for the completion of a first class building are also generally imported. This applies to plumbing and electrical fixtures, ornamental plaster, metal lath, glass, finished hardware, elevators, mosaic tile flooring and paints. The greater part of this material, also, comes from the United States.

Contrary to the general impression, labor is the least of the contractor's worries. This is entirely due to the absence of organized labor unions in the republic. There is little difference between skilled and the unskilled labor. While the common laborer receives $0.75 for ten hours' work, he is the equal of any laborer in the United States who receives three to four times as much. The carpenters and masons get $1.50 for ten hours' work; and while they are not equal to our skilled workmen, they are certainly willing and conscientious and very anxious to learn. Both skilled and unskilled laborers use the old methods taught by and inherited from the Spaniards and the Indians. The laborer is often seen carrying heavy loads on his head; the carpenter saws his board away from him; and the plasterer uses a small hawk, holding but a few handfulls, and throws his plaster carelessly on the wall. The Mexicans seem to accomplish more by piece work, and hence, with a few exceptions like form work, which is comparatively new to them, the most of the work is done in this way.

The writer was in charge of a four story reinforced concrete bank building in Torreon, a northern town of 40,000 inhabitants. It was the first structure of the type erected in the town, and some little difficulty was experienced in securing skilled labor.

The carpenters had never done any form work and so required close watching to prevent their filling the boards with nails. The laborers were willing and good workers, and, owing to the scarcity of rubber boots, were often seen wading barefooted in the soft concrete. It was rather amusing at first to watch the laborers handling the concrete, which was all spouted by gravity.



Type of Concrete Building Built in Mexico.

The building in question was a skeleton of the beam and girder type, with reinforced concrete floors and roof. The facades were of cut ornamental stone, backed with common brick. All the work was done by Mexicans, with the exception of the plastering, which was done by Americans especially imported for this work. The work of the natives on stone cutting was remarkable.

One difficulty the contractors face is the prejudice of the Mexican people against reinforced concrete. This has been largely due to the faulty work that has been done there in the past and is now rapidly disappearing. The fact that the concrete floors are so thin as compared with old unnecessarily thick form of construction reduces any confidence that the people might otherwise have. In their floor construction they still adhere to the old Spanish system of "bovedas." This construction consists of I-beams spaced one metre between centers and arched with two and sometimes three thicknesses of common brick, upon which more brick or plain concrete of unnecessarily great thickness is laid. The completed floor ranges from 15 in. to 2 ft. in thickness from the bottom flange of the I-beam to the top. The arched portion between the I-beams is then plastered and painted, and the bottom flanges of the beams are thus left exposed. This construction not only is expensive and extremely crude, but it also shows lack of economical design and artistic taste.

Since cost of materials for reinforced concrete construction is higher, while that of labor is lower than here, the total cost of such work in Mexico compares very favorably with that of similar work in this country. It is, however, usually safe to count on double the time to complete the same job in the republic that would be needed in the United States.

The customary process of drawing up contracts and specifications is adhered to. Revenue stamps are placed on each sheet of paper according to the amount of the contract. After these are canceled by the contractor, and the whole document signed by both parties and witnessed, the papers are in legal form.

The owners, as a rule, are very lenient with the contractors, and often reward them with bonuses for good work done. They appreciate honest work, and one can always rely on their influence for future work or references. A square deal in contracting in Mexico is what wins the confidence of the Mexicans first of all, and thus assures the contractor success in his business.

The Wisconsin Engineer.

EDITORIALS

An article appeared recently in a current magazine, in which the author went to great length to show that the present war is "a triumph of engineering." It is true that without the wonderful advances in engineering in late years this war would not be so different from any other war as to compel wonder. It is true that without the railroad there could not have been the rapid mobilization of troops; that without the automobile the artillery would lose its efficiency; that without the telephone and telegraph such long lines of battle would be impossible; that without concrete and steel the wonderful fortifications could never have existed. In a few words the contributions of the engineer to the war have enabled more men to be killed in less time than ever before. Where then is the triumph?

Notwithstanding the dominance of war news in every publication and the absorbing interest in the European situation, the bit of news most vital to engineers comes from across the Pacific in China. Three of the foremost engineers of this country have just returned after an exhaustive study of the great flood district of that country. The recurrence of these floods costs China many men and much money annually, and the work of these men is to be in prevention of this loss.

Contrast the two phases of engineering: destruction in Europe, construction in China. On the theory that engineering in the war is a triumph, Professor Mead and his associates should be endeavoring to make these floods twice as destructive! It is an old and time-worn subject, this one of construction and destruction, but not too old to stand new light from present day examples. The engineer can make his work terribly destructive or wonderfully constructive. The whole thing reduces itself to the question of what we consider really worth while. The war gets half the space in every newspaper, and the project in China gets four lines on an inside page. Triumphs cannot be determined by the size of the headlines. It is usually the things that are being done quietly that count for most.

* * *

The Engineering College has reason for congratulation in the temporary appointment of Professor H. J. Thorkelson to be business manager of the University. Besides the personal compliment that this nomination implies it points to the high standing of the engineer as a business man. But it means more than the recognition of the worth of a man; it means more than a compliment to the faculty of the college; it is a recognition of the engineer not only as a specialist in things technical, but as a leading exponent of efficiency.

An examination of the annual report of the Wisconsin Union discloses the fact that of the eight names proposed as additions to the Hall of Fame, two are engineers. These are: Edward Schildauer, e '97, E. E. '11, chief electrical and mechanical engineer on the Panama Canal, and J. G. Wray, e '93, chief engineer, Central Group Bell Telephone Companies.

* * *

The war has brought us face to face with a great new problem in commerce. Nearly every editor in the country has tried to solve this problem in the editorials he has written. The general trend of these solutions involves simply seizing the commerce Europe had, now that it is going begging, and holding it for ourselves for all time to come. There seem to be no suggestions or considerations of difficulties to be encountered in this seizure nor in the tenure after the war is over.

But to the careful thinker real difficulties are present that are worth very careful consideration before solutions are attempted. The investment of large capital must not be risked upon any hasty conclusions that may in time prove false. Dr. Alcan Hirsch, a leading chemical engineer, has seen the real difficulties that would be overlooked in any hasty move on the part of our manufacturers to meet the world's demands for chemicals, and he has pointed out these difficulties at an opportune time in an article in this number of the WISCONSIN ENGINEER.

JOHN SUTHERLAND LANGWILL, m '11.

DIED JUNE 22, 1914.

John Sutherland Langwill was born near Rockford, Illinois, in 1887. After graduating from Rockford High School in 1905,

he taught one year in a country school near that city. In 1907 he entered the University of Wisconsin. He earned his way through the University by working for the Machine Design Department during the school year and the Rockford Drilling Machine Company during the summer. He was a member of Tau Beta Pi, and graduated in 1911 with an enviable record. He immediately went to work in the shops of the Rockford Drilling

Company, where he soon became shop foreman, and then superintendent. In September of the same year he married Irene Shenkenberg, U. W. '10.

Just a year after taking up his duties as superintendent, he developed a brain tumor, and within a month his life was despaired of. He underwent two operations without relief and died on June 22, 1914, at the age of twenty-seven. He leaves his wife and one child, John S. Langwill, who was born two weeks before his father's death.

In his work he showed promise of a brilliant future, and because of his pleasing personality and strict honesty in all matters, was liked and respected by all who came in contact with him.

ALUMNI

With this issue we start the alphabetical arrangement of the Alumni notes. This is done with your convenience in mind. We believe that this innovation will enable you to get more out of the section than before. Any suggestions that you might make toward the improvement of this department will be more than welcome. We are endeavoring to get every change since the issue of the directory before you in these pages, and our success depends upon the active, co-operative interest that you take in them.

M. E. Allen, c '06, is now Secretary of the Central States Bridge Co., Indianapolis, Ind.

B. F. Anger, m '05, is associated with the Anger Engineering Co., Milwaukee, Wis.

A. H. Badger, e '12, has been transferred from the testing department of the General Electric Company to the position of Assistant Engineer of Railway Equipment.

V. W. Bergenthal, E. E. '98, is now Purchasing Agent for the Wagner Electric Mfg. Co., St. Louis, Mo.

W. M. Bertles, g '10, is with Howe, Snow, Corrigan & Bertles, Investment Bankers, Grand Rapids, Mich.

G. B. Blake, E. E. '11, has the position of Assistant Treasurer of the Electric Company of Missouri at St. Louis.

R. Boissard, e '13, is a salesman in the Elux Miniature Lamp Division of the National Lamp Works at Chicago.

L. F. Boon, C. E. '12, is an Assistant Engineer for the Wisconsin Railroad Commission, Madison, Wis.

H. Borchsenius, min '13, is a Consulting Mining Engineer, located at Virginia, Minn.

W. K. Braasch, m '12, who held the position of Efficiency Engineer for the Sheboygan Chair Co., Sheboygan, Wis., is now Sales Manager for the same company.

P. C. Brintnall, min '13, is now employed as a chemist by the International Smelting Company.

J. W. Buchanan, c '06, is Assistant Engineer for the Pacific Electric Railway Co., at 644 Pacific Electric Bldg., Los Angeles, Cal.

J. N. Cadby, E. E. '07, is Division Engineer in charge of Public Utilities Service for the Wisconsin Railroad Commission, Madison, Wis.

C. E. Carter, E. E. '08, M. E. '10, formerly with the Henry L. Doherty Co. of New York City, is now an Engineer with the Mansfield Electric Light and Power Co., Mansfield, Ohio.

Santiago Cerna, c '08, is now a resident engineer at Apartado 58 Aldama 12, Monterey, N. L., Mexico.

S. W. Cheney, M. E. '12, who has been Superintendent for the La Crosse Gas & Electric Co., is now an Assistant Engineer with the American Public Utilities Co., at Grand Rapids, Mich.

F. Cnare, c '10, is with the Wisconsin Highway Commission Madison, Wis.

R. T. Craigo, g '05, is Northwestern Representative of the United Refrigerator and Ice Machine Co., located at 30 N. Seventh St., Minneapolis, Minn.

G. S. Cortelyou, c '08, is now Resident Engineer at Kansas City, Kansas.

E. F. Curtiss, e '10, now holds the position of Commercial Manager with the Brantford Gas Co., Brantford, Ontario, Canada.

G. C. Daniels, m '08, who was formerly a Mechanical Engineer for the Central Illinois Light Co., at Peoria, Ill., is now Superintendent.

L. S. Davis, c '10, is in engineering work at Fletcher, Mont.

R. S. Dewey, '14, is with the Pacific Seed Co., at Salt Lake City, Utah, and not at Caldwell, Idaho, as reported.

McClellan Dodge, c '84, is a consulting engineer located at the Washington Building, Madison, Wis.

R. F. Egelhoff, m '07, is with the Turner Construction Co., 312 Prudential Bldg., Buffalo, N. Y., in the capacity of Superintendent.

O. R. Erwin, e '04, is with the Automatic Chemical Fire Extinguisher Co., 78–81 Loan & Trust Bldg., Milwaukee, Wis.

G. S. Falk, g '10, is Secretary of the Milwaukee Patent Leather Co., Milwaukee, Wis.

C. A. Fay, m '11, is Superintendent at the Last Chance Mine at Wardner, Idaho.

C. R. Findeisen, e '13, now is with the Chicago Telephone Co., where he holds the position of Assistant Traffic Manager.

J. E. Fuller, m '12, is President of the Harrington & King Perforating Co., 614 N. Union Ave., Chicago.

J. C. Gapen, e '03, is still with the Public Service Company of Northern Illinois but is now Assistant Superintendent of District C at Evanston, Ill.

W. G. Gibson, g '08, is now engineer of tests, Flannery Bolt Co., Bridgeville, Pa.

Harold Haley, c '05, is Superintendent of Maintenance of Lewis Co., N. Y., with the State Highway Commission.

F. S. Halladay, c '13, is Chief Engineer of the Green Bay & Northern R. R. at Green Bay, Wis.

L. F. Harza, C. E. '08, is a Consulting Engineer, Spaulding Bldg., Portland, Ore.

C. B. Hayden, e '96, is now on the engineering staff of the Wisconsin Railroad Commission.

E. H. Keator, g '10, is an engineer for the Mississippi River Power Co., 613 High St., Keokuk, Iowa.

W. F. Lathrop, e '02, is Assistant Chief of power plants for T. M. E. R. & L. Co., Milwaukee, Wis.

F. H. Linley, m '10, formerly with the Allis Chalmers Co., is now a mechanical and electrical engineer at Kalispell, Mont.

Rolland E. Maurer, m '14, is at Salt Lake City, with the Utah Gas & Coke Co.

W. C. McNown, c '03, has been promoted from Assistant Professor to Associate Professor of Civil Engineering at the University of Kansas.

A. C. Melcher, m '08, is now Superintendent of The Hoskins Mfg. Co., 433 Lawton Ave., Detroit, Mich.

H. A. Parker, c '08, is with the C. F. Graff Construction Co. of Kansas City, Mo., as a foreman of construction.

W. J. Parsons, c. '00, Assistant Engineer for the American Bridge Co., is in charge of the construction of Hell Gate Bridge, 304 Lincoln St., Flusby, N. Y.

S. H. Probert, c '13, is assistant to the District Engineer, Astoria, Ore.

A. R. Mitchell, c '09, is now in the bridge department of the A. T. & S. F. Railway, 1000 Railway Exchange Bldg., Chicago, Ill.

E. K. Morgan, m '13, who has been chief draftsman for the Rockford Drilling Machine Co., Rockford, Ill., is now Superintendent.

A. W. Nance, c '10, is Assistant Engineer and Secretary of the Farris Bridge Co., 8043 Jenkins Arcade Bldg., Pittsburg, Pa.

O. P. Osthoff, c '10, is a Structural Engineer and Contractor located at 353 Twenty-fourth St., Milwaukee, Wis.

D. P. Pace, C. E. '11, is Roadmaster St. L. B. & M. Ry., Frisco Office Bldg., Kingsville, Texas.

G. H. Palmer, e '07, is in the Electrical Engineering Department of the Washington Water Power Co., Spokane, Wash.

SUCCESSFUL WISCONSIN ENGINEERS

H. H. Scott, e '96.

General Manager, Doherty Operating Co.

Mr. H. H. Scott entered the central station field in 1898 when he became meterman for the Madison Gas & Electric Company. During his three years with this company he worked in practically all of its departments.

In 1901 he became engineer for the Lincoln Gas & Electric Company and a little later its general superintendent. In this position he redesigned the entire station and the distribution system and had charge of all construction work. One year later he was transferred to San Antonio, where his work was of a similar nature in connection with the gas, electric and traction systems. In 1903 he became president of the Traction Company and held this position until he went to New York in 1905. After remaining there one year he went back to Madison to become general superintendent of the Madison Gas & Electric Company.

Since 1906 he has been connected with Henry L. Doherty & Company and the Doherty Operating Company of New York. As engineer for the former, his work consists largely in the examination of reports of public utility properties. For the past three years he has been general manager for the latter company, which operates all the properties controlled by the former.

Mr. Scott has held the membership committee chairmanship and the second vice-presidency of the National Electric Light Association, and was elected president of that body at its June convention at Philadelphia.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