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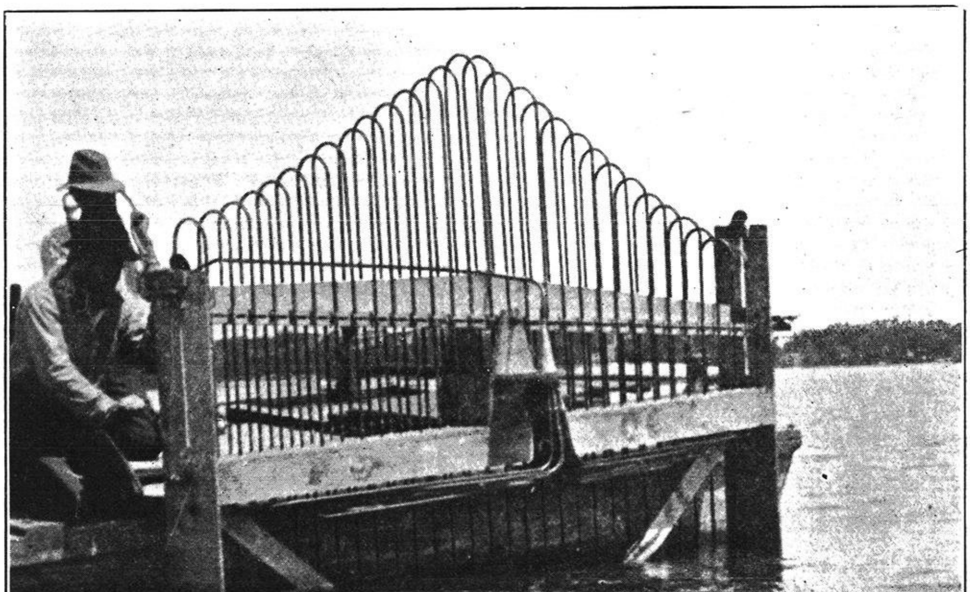

TESTING THE FIRST "M-V" TUBE INSTRUMENT FROM A RAFT ON LAKE MENDOTA.

ARDINAL

SCONSIN ENGINEER TO BE SOLD TODAY

ruary Issue Contains Article y Prof. Max Mason on Submarine Detection

rticles of interest to others than neers are to be found in the ruary number of the Wisconsin ineer, on sale in the Engineer- building today.

mong these is the first of series our articles by Prof. Max Mason 'Submarine Detection by Use of tiple Unit Hydrophones." In article Professor Mason tells he organization of research on marine detectors during the y stages of the war, and of the eral principles of the first detec- as it was tried out on Lake Men-

ther articles include "The En- ering Graduate and Industrial earch" by Dean C. S. Sshlicter, e Engineer as a Dreamer," and French Fire Department in Ac- ," besides the usual editorials, ni notes and campus notes.

WEATHER

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The Wisconsin Engineer
UNIVERSITY OF WISCONSIN

VOL. XXV, NO. 5 MADISON, WIS. FEBRUARY, 1921

SUBMARINE DETECTION BY MULTIPLE UNIT HYDROPHONES

By MAX MASON

Research Professor of Mathematical Physics

Organization of Research on Submarine Detection

Research on methods of submarine dedection was carried on during the war under the control of a special board of the Navy. The board was organized with Admiral A. W. Grant as chairman, Admiral S. S. Robison being appointed chairman soon afterwards. Commander C. S. McDowell was secretary. The other naval member of the board was Commander M. A. Libbey, while H. J. W. Fay, F. B. Jewett, R. A. Millikan, and W. R. Whitney were named as advisary members.

The research work was centered at two stations, one at Nahant, near Boston, the other at New London, Conn. The Nahant group was formed by the Submarine Signal Company, the Western Electric Company and the General Electric Co., the personnel being composed of men picked from the research staffs of these organizations. The New London group was the outgrowth of a committee on submarine detection organized, with the approval of the Navy, by the National Research Council through its chairman G. E. Hale and the chairman and vice-chairman of the Division of Physical Sciences, R. A. Millikan and C. E. Mendenhall. Of the membeds of this committee H. A. Bumstead, E. F. Nichols, and H. A. Wilson experimented at Yale University during the summer of 1917, coming to New London for tests, while Ernest Merritt, G. W. Pierce and the writer were stationed at New London. Facilities for experimentation and tests with submarines were furnished by the Navy at the Submarine Base at New London.

In September the special board formed the Naval Experiment Station at New London. Under the able leadership of Commander C. S. McDowell facilities and personal were at once collected, and experimentation and tests proceeded with great rapidity. Four main research groups were formed under the direction of P. W. Bridgman, Ernest Merritt, G. W. Peirce, and the writer, respectively. A school for the training of listeners was organized, and later a hydrophone school for officers. Production, installation, and maintenance were cared for by appropriate organizations, and close correlation maintained between these different organizations, as well as between the research groups at New London and at Nahant. Through liason officers and interchange of weekly reports research activity in this field in the allied countries was made a matter of common knowledge among the workers. Hundreds of problems were studied by the different experimenters.

The work under the direction of the writer was concerned with the development of submarine detectors in which a large number of individual sound receivers were arranged to focus the sound coming from any particular direction, so as to eliminate disturbing noises coming from other directions, and to enable the operator to determine with accuracy the direction from which the sound came. A brief account of some of the steps in development and a description of the final form of the instruments which operate on this principle is given in the following pages.

This work was made possible in its initial stages, before the establishment of the Naval Experiment Station, by the support of the University of Wisconsin through its War Research Fund, a support secured by the efforts of the chairman of its Research Committee, Professor C. S. Slichter.

During the summer of 1917, Professors E. M. Terry and J. R. Roebuck devoted their time to the work and contritbuted in large measure to the developments. At their return to the University, from New London in the fall, Professor Roebuck started work on an instrument for sound analysis to be used in connection with the design of submarine detectors. He joined the group in New London in the winter, remaining there, while the laboratory work on sound analysis was continued by Dr. Frank Gray, first at Wisconsin and latter in New London. Professor Terry again joined the group at New London in the summer of 1918. Professor W. L. Dabney of the University contributed greatly to the success of the station by his aid in organizing and administering the work of the shops. In addition to those members of the faculty of the University of Wisconsin, the writer had throughout the work the able assistance of Messrs. L. B. Slichter and D. L. Hay, graduates of the class of 1917. Their aid was invaluable and to them should be credited much that was accomplished both in plan and execution. The writer was continually aided by the council of his associates at the Naval Experiment Section, who while engaged primarily along different lines, gave many valuable suggestions. The interest of Lieut. Commander S. C. Houghton, R. N. V. R., British liaison officer on submarine detection, was of especial value,—his enthusiasm stimulated effort, and his unstinted cooperation hastened production.

The problem of determining all the elements of a successful acoustical and mechanical design was one of great complexity. The progress made in the short time was due to the enthusiasm and spirit of co-operation of all who were concerned in the work, a spirit maintained uniformly throughout the personnel of the Navy Experiment Station by the leadership of Commander McDowell.

During the summer of 1918 the writer was engaged with the destroyers and chasers of the United States Navy in European waters, installations being made in English dockyards under the direction of Ensigns L. B. Slichter and Edward Rice, Jr. The work was done under the direct control of Captain R. H. Leigh, head of the anti-submarine division of the Navy in European waters, whose cordial and complete co-operation stimulated all to maximum effort.

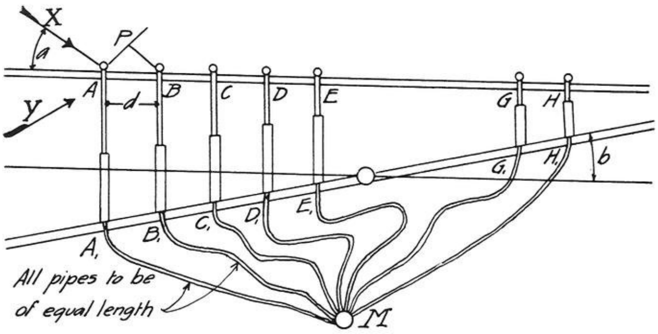

FIG. 1. A DIAGRAMMATIC ILLUSTRATION OF THE HYDROPHONE. *It shows the Process by Which the Differences in Time of Arrival of a Sound at Successive Receivers are Compensated by Altering the Length of the Paths from the Receivers to the Ear.*

General Principles, The First M-V Tube and Compensator

Early in the nineteenth century Calladon and Sturm experimented with sound under water in Lake Geneva. The clearness with which sound produced by metallic objects under water,—the clanking of anchors for example—was propagated to large distances led Calladon to remark that this effect might play an important role in future naval warfare. It is interesting that this prediction was made long before the days of the submarine. A submarine produces sounds under water by its machinery,—main motors, rudder motors, pumps, fans and propeller—and the problem is to detect and locate a submarine through this noise.

Sound under water is not transmitted directly from water to air, but is reflected back, the reflecting power being very high. A sound under water may however readily be heard by simple receiving devices. A good receiver is made by a short piece of soft rubber tube closed on one end, the other end being slipped over a metal tube so as to leave an inch or two of the rubber beyond the metal. The metal tube leads above the surface of the water and to the listener's ears through stethoscope ear-pieces. The compressional wave in the water produces a compression of the rubber tip which sends a sound wave through the air of the tube.

With a single receiver of this kind sounds would be heard, but no idea of the location of their source would be obtained. The direction from which the sound comes may be determined by the use of a pair of receivers. Let these be fixed at the ends of a horrizontal arm which may be rotated under water by a vertical column attached to the center of the arm, the vertical column carrying the sound from the two receivers through two tubes to the listener's ears separately. The listener may determine the direction of the source of sound by rotating the arm about the vertical column until the arm is at right angles to the direction of the sound wave. In this position the sound pulses reach the listener's ears simultaneously and it seems to him that the source of sound lies directly ahead of him. By reading the amount of rotation of the arm on a dial when the sound is thus "centered binaurally" the direction of the source of sound may be determined. The receivers thus act as a kind of extension of the listener's ears into the water, and the same physiological effect is used to determine direction as is used ordinarily for sound in air. An instrument based on this principle, known as the "C" tube, was developed at Nahant and extensively installed.

The main difficulty in submarine detection by sound lies, however, in the fact that, under normal circumstances, the detecting apparatus is mounted in the neighborhood of many sound sources, and the submarine must be heard and identified in the presence of breaking waves, wave slaps against the listening ship, noises originating within the listening ship, and sounds from other ships in the neighborhood. These disturbing noises are many times greater than the sound of the submarine. The difficulty from this cause is especially great when the attempt is made to listen from a ship which is under way.

It is clear that under these circumstances sensitivity of the sound receiving apparatus is a matter of secondary importance. It becomes necessary to devise an instrument which will amplify sound coming from a definite direction, without correspondingly mangnifying the intensity of sounds from other directions. Acoustical instruments, such as sound lenses and the spherical Walzer plates developed by the French navy, may be built by direct analogy to optical focusing instruments. Such instruments must have a great area to show a marked advantage over the single sound receiver on account of the length of wave for sounds in water, and they require large open spaces behind them for their

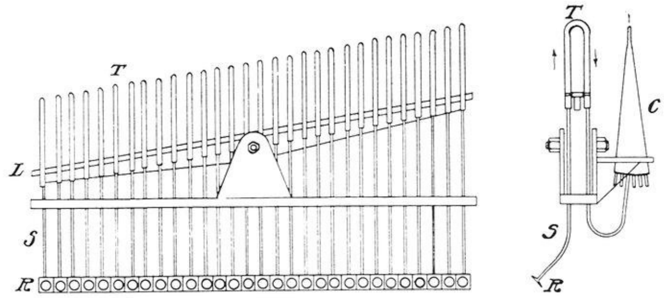

FIG. 2. THE FIRST "M-V" TUBE INSTRUMENT *The sound impulse is received at R and passes to the collecting cone through a path whose length can be adjusted by means of the lever, L.*

operation. In the acoustical case, however, it is possible to connect the members of a group of receivers by tubes to a central collection point and to obtain a focus at this point for sound waves incident at any angle, by properly adjusting or "compensating" the lengths of the connecting tubes. The use of this principle was proposed by the writer at a meeting of the Submarine Committee of the National Research Council and representatives of the U. S. Navy on July 3, 1917. An instrument was at once designed and constructed in the physical laboratory of the University of Wisconsin and tested with successful results at Madison on July 17, and at New London on July 30.

A description of this first instrument may be of interest, for, though crude in construction and difficult to manage, it operated sufficiently well to justify the principles inolved, and lead ultimately to a successful and easily operated device. The accompanying figure (Fig. 1) is diagrammatic only. It illustrates the process by which the differences in times of arrival of sound pulse, coming from any direction, at successive receivers of a line are "compensated" by altering the lengths of transmission paths from the receivers to the ears, so that the effects of the different receivers are superimposed on the ears, while sounds coming from other directions are not brought together in phase. Let A, B, . . H indicate a line of equally spaced receivers mounted, for example, on the wall of a ship. Suppose the paths A_1M, B_1M, etc., are all equal, and that the paths AA_1, BB_1, etc., are composed of trombone slides, the line A_1H_1 being capable of rotation about its center. The paths AA_1, BB_1, CC_1, etc., then differ successively by the same amount, — d *sin b* — dependent on the angle *b*. If sound comes from the direction of the arrow x, making an angle *a* with AH, the instrument will collect the sounds from the separate receivers in phase at M, if

$$\frac{PB}{V_w} = \frac{AA_1 - BB_1}{V_a},$$

where V_w and V_a are the velocities of sound in water and in air respectively, or if

$$\frac{d\ cos\ a}{V_w} = \frac{d\ tan\ b}{V_a},$$

or,

$$tan\ b = \frac{V_a}{V_w} cos\ a = .23\ cos\ a.$$

It is clear that the same angle *b* will compensate for the symmetrical directions x and y of a sound wave. In practice a pair of lines mounted parallel to the keel on the port and starboard sides can be used, and the ambiguity removed either by comparing intensities on the two sides, or by connecting all of the port line to one ear and all of the starboard line to the other.

A multiple unit device of this type,—maximum or binaural or both being obtained by varying tube lengths (variable compensation)—was called an "M-V" tube.

The first actual instrument which was based on this principle consisted of two ten foot rows of 30 receivers each, (Fig. 2). Tubes S, one-half inch in diameter, extended upward from the receivers of each row to a common level, and into inverted "U" tubes which slid over the upright tubes. Fixed vertical tubes led the sound from the sliding "U" tubes and entered the base of a cone, C. The ear piece was connected to the top of the cone. The sliding "U" tubes were driven by a single lever, L, as is shown in Figure 2. Although crude in construction, the instrument showed a fair focus. There were two collecting cones for each row, the halves of a row being led to the ears separately, so that, as the lever was adjusted, the maximum of sound was obtained simultaneously with the binaural center. The illustration on the cover shows this instrument being tested from a raft on Lake Mendota. The trombone slides are seen to be of unequal lengths, their line rising toward the center. The lengths were determined so that the sound paths from all receivers to the collecting cone were equal when the driving lever was horizontal.

In operation, if the tube lengths were adjusted by the lever L for an angle different from that of the sound wave, the sound was heard dimly and confused in character; since one half of the line received the sound as a whole in advance of the other half, corresponding sounds were heard in the ears, but one ear,—the right for example—received the sound before the other. Then it appeared to the listener as if this confused sound were coming from his right. As the lever was adjusted to compensate more nearly, the sound became louder and more distinct, and the source of the sound seemed to move towards a position directly in front of the listener, reaching this position at its maximum of loudness and clearness. Direction could thus be determined to within five degrees. The apparatus was installed in a yacht and much information gained from its use, although its range was but slight and the difficulty in operation very great. More encouraging results were, however, soon obtained when, through detailed study, improvement was made in the type of receivers, methods of connection, and in the compensator.

EDITORS NOTE—This is the first of a series of four articles by Professor Mason on submarine detection.

Flooring for Highway Bridges

A method for providing a satisfactory floor for old steel highway bridges that are too light for a concrete floor, is described by MARTIN W. TORKELSON, Wis. '04, Bridge Engineer for the Wisconsin Highway Commission, in the Engineering News-Record for Dec. 30, 1920. He states that the high costs that have prevailed recently have made it necessary to retain bridges that would otherwise be replaced. A floor built up of laminated units, i. e., planks laid on edge, and covered with a bituminous surfacing was introduced prior to 1917 and has been giving satisfaction. Either tar or asphalt may be used with screened gravel or stone chips as an absorbent. The surface is rolled to a thickness varying from ½-inch at the edges to 2 inches at the center.

THE ENGINEERING GRADUATE AND INDUSTRIAL RESEARCH

By Charles S. Slichter
Dean of the Graduate School, University of Wisconsin

The war is given credit for directing general attention to the economic value of scientific investigation. It is no doubt true that the war promoted a kind of advertising campaign for science that could hardly have been promoted in any other way. The fact remains, however, that great economic forces had been at work for many years and had already converted the owners of many American industries to the importance of scientific discovery. The great scientific laboratories of the electrical companies, of the Eastman Company, of many of the chemical companies are not new. A very incomplete list of about 300 industrial research laboratories recently printed by the National Research Council names very few laboratories whose origin does not antedate the war. The causes which have forced industry to make a close alliance with science have been at work for years—and the industries have blindly felt the force of the movement even though they had not analyzed the causes. As a matter of fact, the outstanding feature of this particular period of economic development in this country is the transition now being made from former means of wealth-production to a newer means of wealth-production. The great growth of national wealth in the past generation in America was primarily due to the taking possession by the people of our natural resources—possession of the soil, the forests, the coal, the minerals, and water power. But the great spurt in the winning of this kind of wealth has now come to an end. It is now clear that some resources are being depleted at a rate that exceeds new discovery, so that it is even probable that less national wealth of certain sorts will be handed down to our children than we received from our fathers. It is doubtful, for example, if the reclamation of land by irrigation, and drainage, and clearing of forest, now materially exceeds the rate of soil depletion. Certainly in one resource—timber—there is important depletion. It is evident therefore that if the curve of increase of national wealth is to go on rising at the same rate as in the past, then enormous increments of wealth must come from a new source—from *scientific discovery*. The betterments, the inventions, the discoveries—whether of new substance, of new processes, of new things, of new scientific laws— in the industrial or scientific laboratories constitute the new sources of wealth for the present generation of Americans. In America the new job seems to be to supplement the wealth of our natural resources, taken over in past generations, by the wealth coming from the applications of scientific discovery. In England the new job seems to be to supplement the wealth arising from foreign trade and natural resources of distant lands, with the wealth coming from scientific discovery. In England, according to the *Annalist,* British manufacturers have established, through associate relations, eighteen research organizations and a number of others are being developed. The industries affected include linen, glass, refractories, leather, cocoa, chocolate, rubber, tires, non-ferrous metals, whale oil, silk, cutlery, laundry equipment, electrical apparatus, etc. The *Annalist* also states:

"The eighteen research associations represent twenty-five hundred firms which have obligated themselves to furnish about £190,000 a year for five years, though it is expeected that the full development of the plans will call for much larger annual expenditures. Ten associations are already at work".

"Parliament also has appropriated a fund of £1,000,000 for the purpose of industrial research. Of this amount about $300,000 has already been disbursed and it is estimated that the Department of Scientific and Industrial Research is committed to something like a total expenditure of $2,000,000 on account of established associations and a further expenditure of fully $600,000 for associations not yet licensed."

"These actual subventions are for an initial five-year period, when it is expected that private interest will be sufficiently established to be financed by the manufacturers themselves. In preparation of this eventuality the cotton industry is engaged in raising a fund of more than $2,500,000 and linen interests are also taking similar action".

In America it is not expected that governmental subventions will be needed or desired. There should be ample leadership developable among the industries themselves and among the graduate schools of the larger American universities. It is the business of the American Graduate Schools, first of all, to furnish the trained men for the industrial research laboratories. It is the duty of the Graduate Schools to get into closer association than in the past with all the industries. At this particular juncture the situation is changing rapidly. Many so-called research departments are really not research departments at all and disappointment is common. In other cases where the plans and scheme of research are of high order, the staff is not highly trained and the results are inadequate. The type of research-man wanted is hard to get. Engineering graduates who are ambitious and will pursue graduate studies for from one to three years have before them very unusual opportunities in industrial research. The undergraduate training in engineering will not take one far in this direction, but is a fine begining. What is especially needed is further graduate training in the fundamental sciences, such as chemistry, physics, metallurgy, etc. The future for men of ability who will take this fundamental training should be bright. Some engineering graduates are attracted to the career of the practising engineer; some are attracted to the business side of engineering; others, I know, would be happiest in the pursuit of engineering and scientific discovery. As Professor Trowbridge recently said, this pursuit should appeal to the spirit of adventure in all red-blooded young fellows of ability. The hunt is for big game. Such a career should be attractive. Even the commercial side is not excluded, but the real interest must always be in the adventure itself.

I believe that a very marked growth of attendance of technical graduates in American Graduate Schools will prove to be the next change we will observe in higher education. I believe such an increase of highly trained technical men is very essential for the future prosperity of America.

INSTRUMENTS AND METHODS USED IN TESTING CONCRETE SHIPS

By Leonard F. Boon, Wisconsin '10

Up to the begining of the Great War little had been done to test ships in service. A few attempts had been made to devise means and equipment for the work, but nothing of value had resulted. Practically all ships are designed according to empirical rules and precedents. Societies have been formed in many countries to collect precedents and to formulate rules for construction and operation. Lloyds, of England, are marine insurance underwriters and to protect their interests, they have compiled rules and regulations under which ships must be constructed before registry in their bureau. The corresponding bureau in this country is the American Bureau of Shipping, and its rules are practically the same as Lloyds.

Nearly all ships built in this country are designed to pass Lloyds' requirements for registry. Since these rules have been under consideration for nearly two hundred years, the result is that ships so constructed are safe, but not necessarily of the most economical design.

When it was decided to use concrete for ship construction a curious situation was discovered: There were no naval architects who knew anything about concrete construction; there were few, if any, concrete engineers who knew anything about ship design; and there were no tests available that gave any information about the stresses and loads to be considered in designing.

One of the first things to be done was to determine the allowable stresses and to ascertain the actual conditions by making a series of comprehensive tests of a loaded ship at sea. Since no such tests had ever been made, there were no precedents to act as a guide in further studies. Tests of structures under load have been made, and bridges and buildings have been tested for some time, but the conditions of testing would be quite different for a ship. It is evident that the most severe condition of operation would be during a heavy sea, and, if the ship could be tested at such a time, the stresses in the various parts of the vessel would be known and proper design could be made. To get some information on these important subjects, Mr. Franklin R. McMillan, assistant professor in the Experimental Department, University of Minnesota, was called in by the Concrete Ship Section of the Emergency Fleet Corporation to devise instruments and methods for making a series of comprehensive tests.

Since the proposed program of tests presented a rather unique problem in both naval architecture and structural engineering, it seems that a brief survey of the early work may be worthy of a place in this article.

Development of Test Instruments

When work was first begun on this problem, March 4, 1918, a contract was under consideration with the Liberty Shipbuilding Company of Boston, Mass., for the building of one or more 3500 ton cargo boats, according to tentative designs by the builders. The first launching was scheduled for April 15th, and the trial trip for late in May or early in June. It was for this trial trip that plans were to be prepared and instruments provided. A trial test on the steamship *Faith*, soon to be launched near San Francisco, was also under consideration. This was scheduled to occur early in May. Time, therefore, was a vital consideration in any plan for developing instruments.

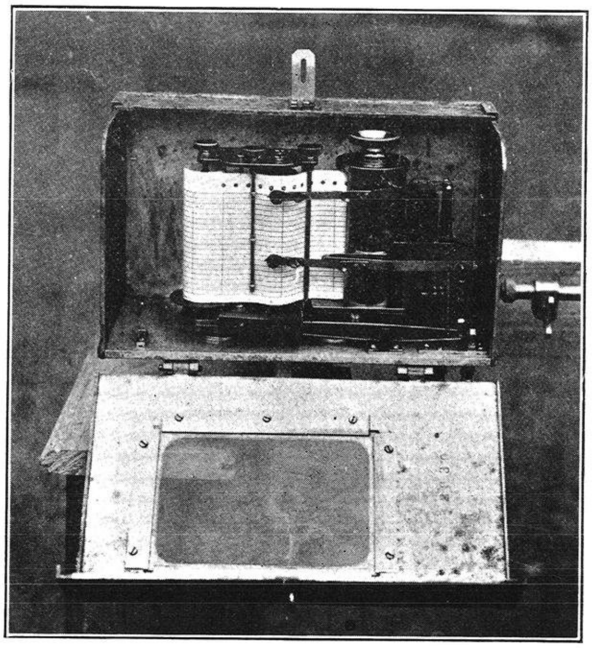

Fig. 1. The Strainagraph used to Measure and Record the Strains in a Ship's Frame: *The forces acting in a ship cause a shortening or lengthening of the various members. The amount of this change in length between fixed points, about 4 ft. apart, is magnified and recorded by this instrument. The stresses in the members can be computed from this record.*

A preliminary study of the plans of the *Atlantus*, as the first ship to be built by the Liberty Shipbuilding Company was later called, was made and a tentative schedule of tests was devised to give important information to be used in the design of future ships. This schedule called for water pressure records at various points along the ship at the bottom and for a distance up the sides, and also for strain measurements to determine longitudinal shear, and frame stresses. All of these were to be synchronized so that simultaneous conditions at all points could be known. The general requirements for the instruments to be used in these studies and the number needed were decided on.

With the principal requirements settled, some of the general features of the instruments were laid out. The makers of various recording instruments were visited with the idea of getting a suitable mechanism for carrying the recording chart,—one that would be readily adaptable to the strain instrument. It was the plan also to find a pressure instrument that would be easily convertible to the needs of the ship test. The research ended at the plant of the American Steam Gauge Mfg. Co., whose pressure instrument, called the "Trainagraph" because it was designed for studying the air brake control of trains, fitted ideally into the requirements of the ship tests. The trainagraph was readily modified to fill the needs of the pressure studies and became the "Pressuregraph", and was used for pressure determinations. The same recording mechanism, case, pens, magnets, and some of the brackets and connections, were perfectly adaptable to the needs of the strain instrument, and, what is of equal importance, the firm was willing to undertake and hasten the work of making these instruments, even though working to capacity on other important war contracts.

Work was begun on March 11 on the first strain instrument. This, together with a modified pressure instrument, was completed in eleven days. The sample instruments were taken to Washington, tried out at the Bureau of Standards, given a sea trial on the *Herman Winter* and returned to Boston in a period of seven days. After slight modifications at the factory and a laboratory trial at the Massachusetts Institute of Technology, the instruments were again tried out at sea, this time on the *Allaguash,* from Boston to Norfolk. After this trial, the instruments were declared successful, and on April 9th an order was placed for twenty-four of the strainagraphs, as these strain instruments were called, and for thirteen pressuregraphs. In response to a request for special haste, the American Steam Gauge & Valve Mfg. Co. delivered eight complete strainagraphs on April 24th, just fifteen days after receipt of the order, and forty-four days after the plans were first laid before them.

Coincident with the development of the instruments, the details of the test were being worked out. A rather comprehensive study of longitudinal stresses and wave pressures was provided for with a somewhat less extensive program for shear and frame studies. Measurements during launching were included. Details for attaching instruments to the ship were devised and arrangements made for preparing the hull of the *Atlantus* for these tests.

The eight strainagraphs, delivered on April 24, were taken to San Francisco to be used on the trial trip and maiden voyage of the *Faith,* the first large reinforced concrete steamship ever built. It is worthy of note in this connection that the maiden voyage of *Faith* was the first occasion of which we have any knowledge when graphic stress records were obtained on a ship at sea.

The experience of this trip was valuable in the consideration of the further program for the test of the *Atlantus.* The trip demonstrated that the strainagraph was a satisfactory instrument for the purpose; the records were, with few exceptions, clean-cut and there were no failures. They showed every indication of consistency and accuracy which gave confidence in the preparations for subsequent tests.

The only change in the instrument resulting from the experience on the *Faith* was the substituting of an electric motor in place of the clock mechanism for driving the record chart. This change seemed desirable for the reason that the speed of the chart when driven by the clock was subject to considerable variation within short periods of time. A constant speed in the travel of the paper is an important item when interpolating for fractions of the time period indicated on the record.

A little thought will show three essential things which must be known before stresses can be calculated in any member of a ship's hull: (1) The position of the waves with respect to the hull; (2) the position of the ship in respect to a horizontal plane; and, (3) the strain or deformation in the member under consideration. All of these things must be known at the same instant, so some means must be had for taking the data from instruments which operated in synchronism. Three classes of instruments were used to obtain data in the several cases: (1) The strainagraph to measure the deformations in the members, (2) the pressuregraph to show the form of the wave, and, (3) the roll-and-pitch recorder to measure the deviation from a horizontal plane.

The Strainagraph

The strainagraph may be said to consist of two essentials: First a lever system for multiplying the small changes of length due to strain between two fixed points on a structure; second, a moving chart upon which the multiplied movements are recorded by a pen at the end of the lever system. Accessory to the essential features, but of vital importance to the adaptability and reliability of operation of the instrument, the following features of the strainagraph should be noted: An aluminum case 5 by 7 by 12 inches in outside measurements, a container and mechanism for the moving chart, an electric motor for driving the chart mechanism, a magnet for synchronizing the records of a number of instruments, a distance bar or plunger, and brackets for attaching the instruments to the structure. The details are quite clearly shown in Figure 1 which shows the instrument as equipped with a clock mechanism for driving the chart. The clock mechanism has since been replaced by a train of gears and an electric motor.

The motors were designed to give approximately the same speed of travel in the charts of all the instruments at varying voltages, so that the speed can be varied alike in all instruments from a central point. The magnet pens of all instruments are connected in parallel to a telegraph relay instrument and a battery of dry cells. The primary circuit of the relay is connected through a small battery of dry cells to a circuit-closing clock, which gives two impulses at each minute and single impulses at either quarter minute or ten second intervals as desired. These impulses, relayed to the instrument circuit, give an offset in the continuous magnet pen line on the charts, from which the records of all the instruments can be compared for any instant of

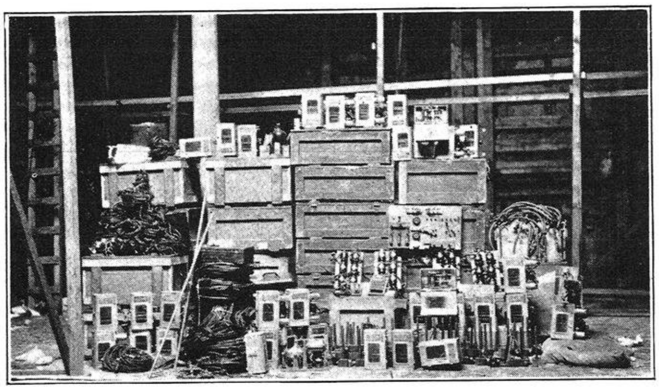

FIG. 3. SHIP TESTING EQUIPMENT.

the test. A telegraph key is also connected in the primary circuit by means of which extra impulses can be introduced further to indentify the records or to record special events.

Measurement of Wave Pressure

The position of the wave was ascertained by the pressuregraph which is similar to the strainagraph. It was designed to measure the head of water above the instrument, so that the form of the wave could be drawn from the records of the several instruments along the side of the ship. It was not expected that this wave would agree with that seen by the eye at any given instant as the crest may be of less density and the trough of greater density than the average head of water, but the wave as indicated will be the effective water pressure causing strains in the ship. It consists of two sylphon tubes open to the sea on one side and connected to a series of levers on the other. The sylphon tube is made of corrugated copper to permit of movement under change in water pressure, but it is water tight to prevent sea water from entering the instrument. On the top of the tube is placed a rod, which is connected to the system of levers, thus permitting changes in pressure to be recorded on the paper rolls. The recording mechanism, case, pens, magnets, and some of the brackets and connections were the same as those used in the strainagraph. The pressuregraph was calibrated by means of a standard pressure gage, or by the measurement of a water column, and the record charts could either be read in feet head of water or in pounds per square inch as desired. Connections between the instrument and the sea were made by using short pieces of rubber hose and standard pipe fittings. Cut-off cocks were placed near the shell to prevent the entrance of water and, after the tests were completed, the holes through the hull were carefully plugged. It will be noticed that no water passed through the instrument, and sharp bends or angles could be used in the connections as the pressure would be transmitted with practically no loss of head. The instruments were placed as low down on the side of the hull as possible, and, in the *Atlantus,* connections were also made through the center keelson. In steel ships, holes through the shell were drilled and tapped, and short pieces of pipe inserted. Corrections were always made for the height of the instrument above the sea connection, and the distance between the bottom of the keel and the sea connection is measured. In this manner the wave test could be drawn using the keel as a base line.

Recording Roll and Pitch

The position of the ship with respect to a horizontal plane was found by a Sperry Gryoscopic Roll-and-Pitch recorder. This instrument consists of a small gyroscope with a vertical axle to which were attached two pens through a system of levers to record the change in position of the ship's keel or deck about the longitudinal and transverse axes. The master clock, used to actuate the magnet pens of the strainagraphs and pressuregraphs was a part of this instrument. It was desirable to place the Sperry recorder as near as possible amidship where the decks and keel are parallel. Near it were placed the batteries, switch-board, telegraph key, and other mechanism used in the tests. The record made by this instrument was used as a master record for all the notes and special data, since the roll ran over a horizontal table and it was easy to note anything of special interest from which the corresponding points on the records of the other instruments could be found.

Attending to the Instruments

A system of signals for time was devised so that the hour and minute could be inserted at about five minute intervals, which proved of great advantage when any of the instruments stopped. One man could look after six or eight instruments depending on the location, and he spent the time going around from one to the other seeing that the pens were full, changing paper rolls, and giving them general oversight. In spite of the careful attention given the instruments before and during the tests, some of them would stop, the pens would fail to work, or something else would happen to cause breaks in the continuity of the records. In these cases it was impossible to have too may marks of indentification for the time. Some of the men became very efficient in checking the poor records and getting the time correctly marked. They would go over the roll until one or more points could be identified and then work both ways from that.

Between tests, the men were engaged in changing instruments, repairing them if necessary, marking the time on the records, and doing other work that was needed. The equipment consisted of twenty-four strainagraphs, twelve pressuregraphs, roll-and-pitch recorder, electric wires for power and lights, storage batteries, hose connections, pipe fittings, paper rolls, repair parts, tools, and numerous accessories. The whole was packed in twenty-seven large cases and valued at about $15,000.

Preparations for Sea Tests

The preliminary preparations for the tests were providing holes through the shell for the pressuregraphs and attachments for the strainagraphs. As the *Atlantus* tests were carefully planned, connections were provided to give all information possible. Connections to the sea were provided at 51 places by putting a piece of copper pipe in the forms before pouring the concrete. On the inside of the shell, nipples with cut-off cocks and hose connections were added before launching. Provision for the attachment of the strainagraphs was made by placing U-bolts around a reinforcing bar before pouring or by placing pipe sleeves through the concrete in the frames and decks. To these U-bolts the instruments were attached by means of heavy cast shoes with hardened steel points to give good bearing on the concrete. Before the tests were run, scaffolding, ladders, and other timber work necessary to support the instruments and to provide safe working places for the men, were built by the carpenters.

The Atlantus Tests

The whole ship testing program was built around the *Atlantus*. Early in 1918, plans were made to run a complete series of tests on this ship and special attachment connections were designed to be built into the hull. Drawings were made showing the location of the various inserts, material for them ordered, and the writer was instructed to be ready at a moment's notice to go to the shipyard and supervise their installation. Delays in the shipyard and changes of plans in the office so altered conditions that is was a year before he saw the *Atlantus;* and then, instead of having forms nearly ready to be filled with concrete, the vessel was being prepared for the trial trip.

The *Atlantus* tests were designed to give an idea of the various stresses in all parts of the ship. To this end 126 strainagraph and 51 pressuregraph connections were built into the hull. As the testing equipment consisted of 24 strainagraphs and 12 pressuregraphs, it was obviously impossible to use all of the connections at once; so a careful program of tests was prepared. These were arranged to show longitudinal compressive and tensile stresses in the keelsons and deck, distribution of stresses across the deck, frame and shell stresses, and diagonal stresses in deck and shell. The pressuregraphs were used to ascertain the effective wave pressures or form of the waves during the tests. A few of the instruments were to be kept at the same points throughout the several series of tests while the others were to be moved from place to place as was necessary to obtain complete data. In this way comparisons of stresses in all parts of the ship could be made without having so many men and instruments.

Launching

Series of tests were to be made at the launching, during the trial trip, and on the maiden voyage. The first and second series were made but the third was, I believe, abandoned. The launching tests were successful and valuable data were secured. The following were the principle results of this test:

Max. stress in deck steel, tension—5400 lb. per sq. in.

Max. stress in bilge steel compression—5250 lb. per sq. in.

Max. velocity of the hull—20 ft. per sec.

Max. draft, at stern—15.0 ft.

Max. draft, at bow—10.0 ft.

Draft in still water, at stern—12.00 ft.

Draft in still water, at bow—7.75 ft.

Time to launch, about—40 sec.

Max. stresses occurred as the hull tipped over end of ways.

Large stresses were caused by the irregularities in the ways, indicating that extreme care must be taken in building the ways for endwise launching of concrete ships.

The following is taken from the official report of the launching and shows the results of this test:

"In conclusion, the more important features brought out by this test may be briefly summarized.

"The scheme of testing which has been worked out and used here gives promise of fruitful results in further investigations.

"The recording pressure instrument has proven very satisfactory. Results from its use in tests at sea will be given the greatest weight because of its performance in this test.

"Likewise the strainagraph, the recording strain gage developed for this work, has proven a success and results from further tests will receive the greatest consideration because of the showing made here.

"The test has shown the importance of care in the construction of ways for endwise launchings of concrete hulls.

"The test has shown that launching stresses may be accurately calculated in advance, that the length of ways and depth of water required for a safe launching may be determined by the usual calculations of the Naval Architect".

The Trial Trip

The trial trip was split up into three parts. It took place off St. Simon's light near Brunswick, Georgia, and all tests required by the United States Shipping Board for the acceptance of ships—except the six-hour continuous run—were successfully passed; but trouble having developed in the machinery, it was necessary for the ship to go back to port for repairs. About a week later, the *Atlantus* was taken to Charleston, South Carolina, where she was placed in dry dock and the bottom scraped and painted. After leaving the dry dock, the trial board met us and the six-hour run was made off Charleston Light. After the board left, the vessel proceeded to Wilmington, North Carolina, where certain repairs and additions to the hull were to be made. It will be seen that the ship was at sea three days, but at separate times. To run a successful test it is necessary to have a heavy sea so that stresses will be set up in the various parts of the hull. The first and second days were so calm that there was not the slightest motion to the hull and it was a waste of time and paper to run tests. As we were leaving the dock, or anchorage, two tests were run to measure the height of the bow wave but the instruments were too far from the cut-water and the speed of the boat before cleaning was too slow to get any satisfactory results. The last time at sea there was some wave motion but the largest steel stresses developed were only a few hundred pounds per square inch; so that we may say, as far as ship testing was concerned, the trial trip was a failure; but as a yachting cruise it was a great success. The testing crew sat on the shady side of the decks, smoked, read, and watched the porpoises play around the bow of the ship.

Docking Stresses

While the trial trip was far from satisfactory, an opportunity was had at Charleston to measure the stresses developed in docking. It has long been known that the stresses developed in launching, docking, and at sea may be different in amount and location in the ship; therefore, the designer should know the maximum intensity from each of these loadings in each member of

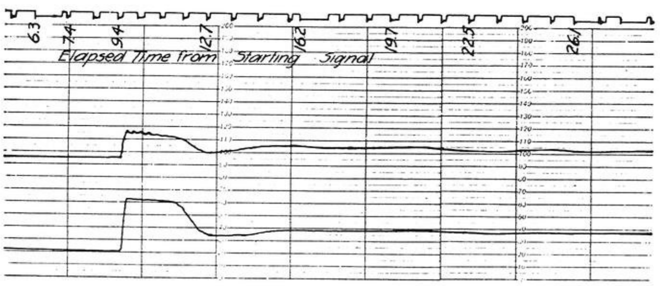

FIG. 2. A PRESSUREGRAPH RECORD: *The long impulses marked 6.3 and 16.2, and the double impulses marked 26.1, were made by the master clock. The pressure records were made by two separate pens and show identical pressure within the range of accuracy of the instrument. The difference in scale is due to a difference in stiffness of springs.*

the ship's frame. In docking, the maximum stresses are liable to occur in the lower parts of the frames, in the keelsons, and in the deck. In this test, strainagraphs were placed to measure the stresses in these places. As the keel and bottom began to rest on the bilge blocks of the floating dry dock, a noticeable amount of deformation was recorded by the instruments. Also a considerable amount of cracking was heard, and later small cracks were found in the lower portion of some of the frames. The maximum steel stresses, however, were not surprisingly large; but were well within those allowed by good design,—about 14,500 lb. per sq. in., as I remember it. At the time the ship left the dry dock, another series of tests were run but the stresses did not appear to be as large as on entering.

Trial Trip of the Atlantus

The trial trip of the *Atlantus* was interesting to every one, as it was the first concrete ship on the Atlantic coast, and no one had any idea of how it would behave. The first thing was to adjust the ship's compasses, which was done by comparison with a standard portable compass. Tests of the engines, pumps, and boilers were made and certain small changes ordered. Considerable trouble was had with the water in the boilers and with the condensers. Many parts of the ship were inspected and the details investigated, but, as this was the first concrete ship seen by the board, few changes of importance were ordered. The ship was run over a figure eight course and the minimum turning circle found by trial. The ship was run full speed ahead and orders were transmitted from the navigating bridge to the engine room through the signal system, for full speed astern. The engines were reversed in about twenty-five seconds and the ship was moving astern in about one minute and thirty-five seconds. It must be remembered that it took more time than this to get the ship moving full speed astern but the test showed the ability of the ship to avoid collisions in difficult navigation. Another test showed the steering ability of the ship while moving astern, and the trial board and navigating officers were greatly pleased to find that the vessel moved in practically a straight line. In fact, the board and officers remarked about the maneuvering qualities of the Atlantus, saying that she was equal to a yacht in these respects and far superior to most cargo boats. The anchor chains and winches were tested by dropping the anchors in about ninety feet of water. Defective shackles were found in each chain and special precautions were taken to prevent loss of the anchors and portions of the heavy chains. On the return to port, the chains were removed and the defective shackles repaired. All tests were successfully passed except the six-hour run; this test was started, but, because of the difficulties in the engine room, the exhausted condition of the fire-room force, and the shortage of fresh water, the ship was returned to port. The pilot was taken aboard outside the bar, and, because it was a concrete ship, he was nervous and caused the ship to run aground. The Captain (W. W. Eger of Chicago, a captain on the Great Lakes) took charge and succeeded in freeing the ship without any damage.

The whole program was not only interesting but opened up a new field to the testing engineer. Enough tests were made to show the reliability of the instruments and methods used and that the results are of great practical value. It is to be regretted that the work could not be carried through a period of years with ships of different sizes and classes.

The writer wishes to acknowledge his indebtedness to the unpublished reports: "Test of the Steamship Atlantus" by F. R. McMillan, and "The Side Launching Test, 6000 Ton Vessel" by F. R. McMillan. He is also greatly indebted to H. R. Thomas for a portion of the data, a description of the strainagraph and the operation of a group of instruments, and for the history of an early part of the development of the tests, which have been used nearly verbatim.

WHAT ARE THE CHIEF DEFECTS IN THE PRODUCT OF ENGINEERING SCHOOLS?*

By B. F. GROAT
Hydraulic Engineer, Aluminum Company of America, Pittsburgh, Pa.

This question must be considered broadly by the teacher, especially when determining his general educational policies and when establishing his courses of study.

During the last ten years I have employed a number of college graduates from a number of colleges and universities and while these men have had their faults, I have found it very difficult to lay my finger upon the faults which it would appear are in any special sense those due to the methods applied in their engineering education.

It seems to me that the principal faults which can be traced to their education are divided into two classes: (1) lack of capacity in the sense that a machine has capacity; (2) lack of general education.

Lack of capacity shows itself in measuring the ability to turn out a large output as in:

1. *Making Routine Reports.*—It was frequently observed that engineering students lack a knowledge of clerkship and a knowledge of the methods of securing accuracy. They frequently do not understand how to check a report so that all of the errors will be discovered and eliminated. Any high grade clerk can do this. They lack a training in many of the duties required of a clerk.

2. *Surveys.*—Very frequently engineering graduates lack capacity of manipulation. It takes too long for them to do very simple things. They lack diplomacy in many cases. Diplomacy is very necessary when making a survey on foreign ground.

3. *Tests.*—Engineering graduates very frequently fail to produce satisfactory test results. The failure of capacity in this respect is very similar to the failure of capacity in clerkship and accuracy.

4. *Estimates.*—In many estimates it is frequently the case that graduates fail to evaluate and correctly weigh the data at hand.

5. *Designing.*—It is very frequently the case that young engineering graduates fail to distinguish the difference between what should be called correct engineering and what should be called individual judgment. This misconception is not confined to young college graduates. It is not safe to substitute the judgment of an individual for the criteria of correct engineering.

Lack of general education does not show itself merely as a lack of refinement and finish. It goes entirely to the root of fundamentals. Clear conception of ideas is an absolute necessity in engineering; I should say more so than in any other branch of activity. Probably nine-tenths of engineering knowledge comes through the study of the definitions and meanings of words. This applies not merely to technical words but to all kinds of words. I should say that the study of a science is largely a matter of arriving at a clear conception of the meanings of the words which have been employed by the teachers and writers in describing that science. It is true that we seem to think that we have ideas of a science which are peculiarly our own individual ideas; and yet, we must admit that our own individuality in any particular line of activity consists principally in a display of individual energy rather than in an evolution of new modes of thought.

The engineer should study languages. It must be admitted, however, that he cannot take time to go into the details of languages to the same extent that should be required of a person contemplating a literary life. Perhaps one of the greatest fields for the engineering schools to develop is the proper method of instructing the students in the languages. It may not be amiss to suggest that the engineer should have as thorough an education in English as any other class of student, but that he should thereafter absorb the general nature of the other languages by actually reading and translating important technical articles on important subjects with which he is already familiar. Of course there should be a very brief and concentrated study of the simpler elements of construction of some of the languages, but this should be merely an introduction, on the ground that a certain amount of such preparation is on the side of economy.

The student's ideas will be greatly broadened, and an immense amount of extremely valuable information will be acquired, by reading generally on important subjects such as law, economics, politics and finance. Such courses of reading should be supplemented by a course of lectures by real experts in the various branches.

These methods are bound to lead to general largeness covering all branches of engineering, and, indeed, will make the student at home in almost any society.

The lack of capacity in general education seems to result from a lack of breadth of courses and from too much time expended on small things. The student should be compelled to dig down to the merest detail in his studies at critical times. He should be trained to go to the ultimate degree of refinement in detail, but it is destructive of his mental development to keep him grinding on these details continuously.

Engineering students should not take too much vacation. Two weeks a year with the ordinary holiday vacations should be plenty. However the conditions are today, it is a fact that the most inefficient institutions we have had in the past have been our schools. An engineering school should be in daily operation the year around. It should keep in touch with its output of college graduates.

One of the best means for keeping in touch with the college graduate is to direct him in his early years toward proper lines of occupation and to advise with him as regards the salary he should expect and demand. One of the reasons why ordinary engineers fail to receive the compensation to which they are clearly entitled is because they do not know what their services are worth, nor do they know what they can demand. In most cases

* Read at the first regular meeting of the Pittsburgh Section of the Society for the Promotion of Engineering Education, Wednesday evening, December 3, 1919 and printed in The Bulletin of the S. P. E. E., February, 1920.

they do not even know what their fellow engineers are getting in the way of compensations and the custom has grown up to a large extent whereby each man has to pull for himself.

The question of discipline is extremely important; it is hardly necessary to go into this matter at the present time but it may be remarked that students frequently do not feel a proper sense of responsibility.

Whatever the conditions are today in our engineering colleges I can say that I was firmly convinced of the fact during fifteen years of college life, in which I acted as student in engineering, student in law, instructor in engineering physics, assistant professor and professor, that there is too much formal class room work and too little time for independent thought and action. The tendency of this state of affairs is to rob the student of a certain kind of initiative force that ought to be developed fully.

I am inclined to think that there should be no formal class room work after the Sophomore year; that the student should work four hours each day in practical engineering and devote another four hours to reading and attendance upon high grade engineering lectures.

THE ENGINEER AS A DREAMER

By Earl K. Loverud
Junior Civil

Much has been said about the engineer being a thoroughly practical man, and to some he may be thought of as a man who thinks only in terms of feet per second, pounds per square inch, stress and strain, and so forth. Unlike many other people who live only in and for the present, the engineer is somewhat of a dreamer; not a dreamer of the lethargic type that hies himself to the occult orient to spend his life in idleness or in the quest of pleasure, nor yet one who is necessarily given to caprices. An engineer dreams, but his dreams are not ephemeral as are those of the usual dreamer; and he does not allow his dreams to run wild; he practices coercion.

The engineer dreams,—yes, but his dreams are capable of taking on a material form. For instance, he creates in his mind a picture of an undeveloped river, sees tremendous possibilities for the development of usable power, builds a dam and power station at a suitable location along the stream, constructs transmission lines, and furnishes the neighborhood for miles around with electrical power—in short, he transforms one of nature's abundant resources into a useful agent.

He sees before him, perhaps, a vast country which lies waste because nature, in endowing the particular region, neglected to give it sufficient water for agricultural purposes. Many miles away, there is a stream, the course of which the engineer, in his minds eye, carefully surveys, and directs by digging channels and obstructing its former course, to the region which is unprovided with water. At once the land takes on a new value, and is eagerly settled. Continuing his dream, the engineer builds a railroad to afford the new district communication with the rest of the country; then he proceeds to construct highways, and telephone and telegraph systems. In a few years, as population grows, there is need for a definite city plan, with its attendant water, gas, sewage, street, and electric lighting systems. The engineer takes care of each of these needs; and then he turns his attention to the construction of large office buildings and to the development of manufacturing industries.

Or, again, the engineer may imagine he sees in some out-of-the-way place iron ore hitherto unmined because of supposedly insurmountable obstacles. He devises some method of economically getting at the ore, sinks a shaft, builds a railroad line to the mine, puts up laboratories, washing plants, and furnaces, and finally brings to the world a new supply of raw iron, which, if further interested, he transforms into useful machines, rails structural beams, and so forth.

The engineer, in pondering over the defects of an engine, suddenly mentally creates an improvement in steam or gas engines. A systematic drawing of his new invention takes form in his mind, and after a time, engines become more efficient.

So, it can readily be seen that the engineer must truly be a dreamer,—must develop his imagination—for it is indeed visions such as those mentioned that spur the engineer on to greater efforts to attain his ultimate goal—that of utilizing the materials and forces of nature for the benefit of his fellow-men.

A FRENCH FIRE DEPARTMENT IN ACTION

By C. N. Maurer, m. '16
Mechanical Engineer, Wisconsin Highway Commission

While in overseas service the writer and several fellow officers were one day dining at the Cafe de la Paix in La Rochelle, France, when the attention of the party was attracted by the appearance of what seemed to be a very joyous procession moving slowly down the street. About 25 Frenchmen, very oddly clad, proved to be the center of attraction. Their uniforms were of various cuts and styles and their helmets were of sizes varying from the size of a freshman's cap to that of a large "Sou'wester." Their coats were blue with gold epaulets of different sizes and no small amount of gold braid. The prevailing style varied from a dress suit cut to that of a Prince Albert. All buttons (and there were many) were of silver. The breeches were red with blue stripes of various widths. Each man wore a large, greenish colored cape lined with bright red, which was fastened at the neck, the sides being thrown back over the shoulders, all making some color contrast to say the least.

The men were making some pretense to keep in step and in some kind of a line, the step being a poor attempt to copy the famed goose step. Leading these men was a man clothed in a uniform covered with enough gold braid to have made Von Hindenburg, in his prime, look like a buck-private.

As the procession marched along, people came from the places of business enroute, carrying bottles of wine and cognac which were tendered the marching men. Upon inquiring, the writer found that this procession was the city fire department on its way to a fire, so he joined the crowd. The fire was in a frame building down on the waterfront, a distance of six or seven blocks from where the procession was first observed. By the time the fire department reached the fire, each man was carrying at least one bottle of wine in his hand and several otherwise. The firemen stopped in front of the building and lined up, facing the fire, in lines something like a "company front." The chief assigned a duty to each man, which took several minutes, then about faced them by a whistle blast. On the second blast each man walked to his post. Several pails of water were thrown on the fire, but beyond that the writer was unable to observe any work done by the firemen otherwise than to promote the wine industry. After the fire was over, the building having burned to the ground, the men, those that were left, were again lined up and marched back to the Hotel de Ville to make their report to the mayor. The wine had started to show its effects on the men and as they marched they resembled a bunch of Huns who had suddenly been forced to change their direction of procedure

There are very few fires in France because of the few frame buildings, and in Aigrefeuille, a village of perhaps four hundred inhabitants where the writer was stationed, there had not been a fire in twenty years.

WAVE TRANSMISSION OF POWER

There are at present five methods in commercial use for the transmission of power, namely, steam, direct mechanical, electric, compressed air, and hydraulic. Wave transmission, or "sonic" transmission, is the name used to describe a sixth method in which waves or pulsations are set up in an enclosed column of liquid. The liquid, usually water, is contained in a flexible pipe connecting the apparatus generating the wave motions to the machinery which applies them to useful work. The principle of the method is absolutely distinct from that of hydraulic transmission. In this new form of transmission, there is no continuous flow; the particles of liquid merely pulsate backward and forward about a mean position. The pressure impulses set up by the wave-power generator travel through the liquid with the speed of sound waves, and deliver their energy to the wave power motor. Electricity offers an excellent analogy to explain both hydraulic and wave transmission. Direct current may explain the ordinary hydraulic transmission and alternating current, the wave transmission.

The wave generator consists of one or more metal cylinders, each fitted with a piston connected by a crankshaft to any type of high speed prime mover, such as steam, internal combustion engine, or an electric motor. The wave motor is composed of one or more metal cylinders, each fitted with a piston designed to receive the power wave at the intake end. The other end of the piston is suitably connected to the toll or machine desired to be operated. The simplest application is found in such appliances as rock drills and riveting hammers. The possibilities for this new kind of transmission of power are wide, almost unlimited.

CIVILS NAME OFFICERS

Officers have been elected to head the Civil Engineering Society for the second semester. They are, Herbert Wheaton, president; James R. Price, vice president; O. N. Rove, secretary-treasurer; H. M. Ford, critic; A. R Striegl, publicity agent.

THE STUDENT BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Student Branch of the A. I. E. E. held an "electrical initiation" on the evening of December 16th, followed by an Orph party. It is rumored that the power for the lights at the Orph that evening was furnished by escaping electrons from the new members! Judging from the input during the earlier part of the evening, it seems plausible.

At a meeting of the Branch held January 12th, a paper on "Naval Aircraft Radio" was given by M. P. Hanson. The paper was enlivened by some of the personal experiences of Mr. Hanson, who was with the Naval Aircraft Radio Experimental Service during the war.

At the last meeting of the semester, January 26, the following officers were elected for the coming semester:

R. E. Hantzsch, chairman: R. H. Herrick, secretary: Professor Edward Bennett, C. M. Morley, M. D. Jackson, executive committee.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The A. S. M. E. has just completed one of its most successful semesters since the organization of the University of Wisconsin chapter in 1910. This was manifested by the excellent talks given by the senior members of the organization and by the increased membership. The present membership is 54, being surpassed only once in the history of the U. W. chapter. Of this number, 30 juniors and 6 seniors risked the horrors of the initiations during the last semesters.

The officers recently elected for the second semester are:

Edward T. Donovan, Pres.
Clarence W. Peterson, Vice-pres.
Marshall Bautz, Sec.
Paul W. Royer, Treas.
Jack Rubenstyne, Publicity Ag't.

Educators agree that the mental processes are powerfully stimulated by environment. It is too late to make use of the suggestion at this examination period, but, for the sake of coming generations, we suggest that hereafter the Steam and Gas exam be given in the boiler room of the heating plant, or that the Hydraulics exam be written by students clothed in bathing suits dabbling their feet in the limpid waters of fair Mendota.

Engineers in Ship 7 are to make sensitive drill presses for the new shops.

Sort of "light on the trigger" effect, eh?

EDITORIALS

WHAT IS THE POLYGON?

The Polygon is to be the executive committee of the engineering societies. It is to be composed of two members, one senior and one junior, elected from each of the engineering societies. As stated by its constitution, the purpose of the Polygon is to further the interests of the engineering college. The constitution, in providing for the election of members from the societies, insures that every one so chosen will be active and well known in the college.

The ENGINEER welcomes the advent of the Polygon, and assures it of heartiest co-operation in promoting the best interests of the college.

ROUNDING INTO FORM

Slowly the ENGINEER is approaching the form that we have in mind for it. This issue bears on the cover page a new design contributed by Mr. L. S. Baldwin, instructor in drawing, which adds greatly to its appearance.

WHAT DETERMINES?

Are you going to be an engineer? yes, going to be,—but when? What determines? Will graduation make the senior an engineer? These questions cannot be exactly answered. One thing is certain, however. The sooner one identifies himself with engineers the sooner will others recognize him as one. One way is by becoming identified with an engineering society. As a member,—a live member,—a man will meet with all types of men, will be benefitted by some, and can, in turn, benefit others. There is untold benefit to be gained from being subject to the influences of an engineering society, from taking an active part in the discussions, asking questions, and being a *real* member. To associate with others and take part intelligently in discussions, one must know what men are doing. The live engineers talk to each other, not only vocally, but through technical papers, and the constant habit of closely following discussions in the professional magazines is a most valuable one. By learning how others think and reason, and by knowing what is new, the engineering student can fulfill two of the requirements of being an engineer. W. C. T.

UTILIZING THE DRAFTING PERIOD

It is fortunate that there are few visitors to the drafting rooms of the College of Engineering during periods after drafting hours. More time is spent during such periods in thinking of mental trash than is actually spent in drawing. If the student concentrated on the work in hand and held his mind to technical channels, he would have to spend very little time outside class hours, and what he did spend would be of much more benefit than the time which he spends in idle conversation.

THE UNIVERSITY EXPOSITION

The faculty have placed their stamp of approval on the University Exposition, and plans are being made rapidly for staging this event the last of April. William B. Florea has been appointed general chairman and the entire college should co-operate with him in making the affair a success. Plans for the staging of the electrical show have been altered and the exhibits originally planned for the show will be a part of the exposition. Seniors and juniors in all the courses should see that the engineering college is represented by ingenious and attractive displays second to those of no other college of the University.

LICENSING THE ENGINEER

One of the questions before the engineer today is whether or not the engineer should be licensed. It is a question which will have to be discussed and finally decided in the near future, and consequently every serious minded engineering student should inform himself of the advantages accruing to the public and to the profession from a licensing law.

Legislatures in many states have already passed such laws, and those of other states will soon consider similar statutes. In view of this fact, and in order that engineers may not be hindered in work which may take them from state to state, it would be well for every state to consider and pass licensing laws in the near future.

CO-OPERATION BETWEEN ENGINEERING AND MEDICAL PROFESSION

There has been some controversy over the technical limits within which the engineering and medical professions should practice in the field of sanitary engineering. It is really difficult to differentiate the fields of the two professions. In a narrow way, the engineer is one who is trained in the application of physical science to structures, while the physician is trained to overcome disease. Many times physicians have assumed a knowledge of the sanitary arts which was wholly unwarranted. The engineer has failed at times because he neglected the human element too much. The physician has been trained to study the individual, the engineer the mass. It is not surprising that there have been founded in some of our leading universities, public health schools which are open to the graduates of engineering science and medicine. These schools attempt to fill in the break between the two professions,—to co-ordinate more fully the efforts of the two.

The situation will probably remedy itself. Certainly one condition must result: A greater degree of co-operation will be secured between the engineering and medical professions. L. E. C.

ALUMNI NOTES

By DAVID W. MCLENEGAN

This column is not conducted by Harvey T. Woodruff, but HELP! HELP!

A. O. AYRES, c '16, is manager of the Eau Claire Sand and Gravel Co., Eau Claire, Wis.

GEO. J. BARKER, min '20, has been appointed instructor in the department of mining engineering. Previous to his graduation he has been with the Anaconda Copper Mining Co., at Great Falls, Mont., and has had eight years assaying experience with the Zinc Refining Co., at Cuba City, Wis.

K. C. BARROWS, e '20, is enrolled in the student course of the Western Electric Co., Hawthorne, Ill.

FRANCIS L. BAYLE, m '19, is with the Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass. He resides at 170 Kent St., Brookline, Mass.

P. W. BEASLEY, c '10, is a civil engineer employed on railroad valuation work, at Hillsdale, Ore.

HORACE M. BEEBE, c '11, is a contracting engineer for the Fairbanks-Morse Co., Chicago, Ill. His home is at 4145 Michigan Ave., Chicago.

CHAS. E. BENNETT, ch '12, has left the Madison Gas & Electric Co., to become vice-president and general manager of the Binghampton Gas Works, Binghampton, N. Y.

FRED M. BLACKBURN, e '07, is city engineer at Soda Springs, Idaho.

FELIX W. BOLDENWECK, m '02, is sales engineer. He resides at 450 Oakdale Ave., Chicago, Ill.

LEONARD F. BOON, c '10, C.E. '12, formerly instructor in the department of railway engineering at Wisconsin, has recently been appointed instructor in civil engineering at Minnesota. His address is 312 16th Ave., S. E., Minneapolis.

G. GILBERT BOTHUM, c '16, is with the Bureau of Design, Board of Local Improvements, Chicago. He is engaged in the design and layout of a number of street improvements under the Chicago Plan Commission. His address is 163 W. Washington St.

J. E. BOYNTON, m '05, is engineer for the Corning Glass Works, Corning, N. Y.

BERNARD C. BRENNAN, c '05, is city engineer of Kenosha. Wis.

O. B. CADE, e '06, is president and manager of the Tri-State Battery Co., distributors of Prest-O-Lite batteries and tanks, operating in Iowa, South Dakota and Nebraska, with headquarters at Sioux City, Iowa. He visited the University a short time ago, while on his way to his home town, Viroqua, Wis.

LAWRENCE F. CAMPBELL, m '20, is with the Diamond Chain Co., Indianapolis, Ind.

EDWARD H. CARUS, ch '12, is president of the Carus Chemical Co., LaSalle, Ill. His is said to be the only factory which made calcium permanganate for the Gas Defense Division during the war.

A. B. CHADWICK, JR., ch '10, is manager of the Caustic Soda Department of the Solvay Process Co., Detroit, Mich. His home address is 1656 Pingree St., Detroit.

MANLEY CLARK, ex-ch '21, is at Kennecott, Alaska, with the Kennecott Copper Co. He is shift foreman in the refining plant.

EVERETT L. COLE, ex-e '18, engineer officer of the U. S. S. N-7, has been granted a furlough to visit his mother who is reported to be seriously ill.

GLENN P. COWAN, e '11, is vice president of the Arctic Ice Cream Co., Detroit, Mich. His home is at 507 Grand River Ave., Detroit.

"BOB" CONNELY, c '16, was married to Miss Mary Brill of Appleton, Wis., on January 29.

"PAT" DOWNEY, m '20, is vice-president of the Downey Heating & Supply Co., Milwaukee, Wis. His home address is 2427 Grand Ave., Milwaukee.

D. L. FAIRCHILD, c '90, has removed from Duluth to 2820 Park Ave., San Diego, Calif.

WILLIAM J. FREEMAN, m '07, ME '15, is a member of Sloan, Huddle, Feustel & Freeman, consulting engineers, 1745 Conway Bldg., Chicago, Ill. His home is at 1929 Estes Ave.

EDGAR A. GOETZ, g '04, is a structural engineer and resides at 2186 Doswell Ave., St. Paul, Minn.

CHARLES GOLDAMMER, e '17, writes from Elkhart Lake, where he is in business with his father. Goldie congratulates the Engineer on its change in size and on "keeping up the old standard."

S. C. GRIBBLE, ch '17, visited the University during the Christmas vacation. He is instructing in Physics and Chemistry at the Waterloo High School, Waterloo, Iowa.

F. L. GRISWOLD, ch '20, visited Madison during the holidays. He is employed in the factory of the Westinghouse Lamp Co., at Newark, N. J.

LEWIS W. HAMMOND, c '10, is assistant project manager, Aviation Section, Bureau of Yards & Docks, Navy Department. His address is 1221 Michigan Ave., N. E., Washington, D. C.

CLARENCE HANSON, m '20, is with the Standard Oil Co., and is located at 1017 West 47th Street, Los Angeles, Cal.

WALTER A. HATCH, c '11, is an engineer with the Illinois Appraisal Co., Chicago, Ill.

F. W. HUELS, e '03, is publicity director of the Industrial Commission of Wisconsin. His home address is 115 State St., Madison, Wis.

ARTHUR E. LIEBERT, m '20, is with the Bucyrus Co., South Milwaukee, Wis. His home address is 685 Holton St., Milwaukee, Wis.

H. E. LINDEMAN, m '20 is with the Nordberg Mfg Co., Milwaukee, Wis. His home address is 1322 Vliet St., Milwaukee.

F. D. LOHR, ch '16, is superintendent of the By-Products Bldg., of the Seaboard By-Products Co., Jersey City, N. J. His home address is 161 N Parkway, East Orange, N. J.

JAMES D. MCCONNELL, e '20, is in the engineering department of the Prairie Pipe Line Co., with headquarters at Independence, Kans.

H. E. MCWETHY, e '09, has left the Railroad Commission and is in Philadelphia on appraisal work for R. Feustel.

R. L. MEYER, m '20, is with the Kimberly-Clark Paper Co., Kimberly, Wis. His home address is 473 Eldorado St., Appleton, Wis.

JOSEPH OESTERLE, ch c '14, has been appointed assistant professor of metallurgy and research assistant in the department of mining engineering. Previous to his appointment he has been employed in the laboratories of the U. S. Bureau of Standards, Washington, D. C.

CLARK M. OSTERHELD, e '14, is an engineer with the Stoughton Wagon Co., Stoughton, Wis.

C. A. POTTINGER, e '18, is engaged is sales engineering work for the Richards-Wicox Mfg. Co., and is at present located in Aurora, Ill. He expects to return to Milwaukee, Wis., within the next few months.

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ENGINEERING REVIEW

By M. A. Hirshberg

Moving Platforms Proposed to Displace Subway Cars

A series of traveling platforms, each moving three miles an hour faster than the preceding one, has been proposed by a firm of consulting engineers for cross-town use in New York City. This novel idea is not a new one, for such a system was actually operated at the World's Fair at Chicago in 1892, and in 1902 Gustave Lindenthal, the noted bridge builder, wished to install moving platforms over the Brooklyn bridge. Present conditions afford an opportunity for a serious consideration of the method by the Public Service Commission of New York.

The scheme proposed is to use three sets of platforms with a combined width of about 12 feet, the fastest one to carry covered seats of two passenger capacity. Each platform unit is to be supported on motor driven trucks the electrical elements of which are of identical construction but are to be driven at the required speed by currents of varying frequency. Whether or not the system will be installed in New York is unknown, but its successful operation may be of great importance to the street transportation industry.

Insulation Research

The National Research Council has entered into an extensive campaign to investigate the principles of insulation, a matter of vital importance to the electrical industry, we learn from the Electrical Review. A meeting of the Council's insulation committee was recently held in New York City, Mr. F. B. Jewett, of the Western Electric Co., presiding. For some time past the National Research Council has been endeavoring to formulate a practical plan whereby cooperation between universities, the industries and the National Research Council might be accomplished in attacking the problems involved in fundamental research upon insulating materials.

One Million Horsepower From Tidal Energy.

It is noteworthy that the first attempt to make use of tidal energy for industrial purposes should be on such a large scale as to far exceed any of the world's existing hydro-electric installations. The British government scheme proposes to utilize the energy of the 30 ft. tide which ebbs and flows in the estuary of the River Severn, England. The proposed dam is to be 3½ miles in length and is to be built across the mouth of the Severn estuary, the distance from shore to shore being 2½ miles. The tide will flow through inwardly-opening sluice gates out to the sea, and a large number of hydraulic turbines will be built within the dam itself. The arrangement in brief is to have a main generating plant located in the dam itself capable of delivering over one million horsepower which will operate when the difference in water levels above and below is great enough to warrant the turbines operating efficiently. These periods of operation will of necessity be intermittent due to the changing tides. An auxiliary plant to operate during the idleness of the main plant is secured by damming the River Wye, a tributary of the Severn, and forming an auxiliary reservoir. Since the total amount of electrical energy will be in excess of the amount required at times, the surplus current will be utilized in an electrical pumping station used to pump water from the Wye into the above-mentioned high level reservoir. During portions of the day one or the other of the plants will be idle, depending upon tidal conditions, but at other times the plants will be working in parallel. It is expected that many industrial plants will be attracted into the neighborhood of this mammoth generating station by the prospects of cheap building sites, abundant electrical power, and good rail and shipping facilities.

The Unit System of Freight Handling

The Trinity Freight Unit, developed during the war by the River and Rail Transportation Co. of St. Louis, promises much toward the facilitation of rail and water shipment of freight. The units are metal containers made in various sizes from 2½ to 10 tons capacity and in various designs for different kinds of freight. They are filled at any place convenient for the shipper and may be hauled by motor truck to the railroad or shipping wharf where they are loaded by cranes on to special flat cars or boats. The units seem to be especially advantageous for less-than-car-load freight. They may be locked securely and remain unopened from consignor to consignee, thus avoiding loss from thieves and from damages at present due to rough handling of packages by freight handlers. The advantage of the ease of transferring the units from one carrier to another is obvious, and the elimination of much idle time of freight cars while loading and unloading is a great economy in the use of rolling stock.

How large is $\frac{1}{200,000,000}$ Inch?

An instrument which measures 20,000 times finer than the present screw-micrometer has been recently perfected by a professor of Leeds University. The method employed is based upon electrical phenomena and is described in the January, 1921, number of Mechanical Engineering. So sensitive is the new instrument that it will measure the deflection of a solid wood table when a coin is placed upon its surface. The instrument's future uses in measuring the effects of small loads on structures and the effects of temperature on the expansion of metals are only a few of the many applications to engineering research. Its importance is realized when one reflects that our knowledge of natural phenomena is limited only by our inability to collect accurate data.

Surveying the Snows

California and Nevada have joined hands with the U. S. Weather Bureau in a new field of research,—the measurement of the annual snow fall in the mountains for the purpose of forecasting the amount of water for power and irrigation that may be expected each year. According to an article by James Anderson in the Scientific American this undertaking is the outgrowth of about ten years of observations and measurements conducted by Dr. J. E. Church, Jr., of the University of Nevada. Dr. Church's winter pleasure and sport trips in the mountain snows first gave him the vision of the great and useful service which an accurate forecast of available water would be to the farmer and manufacturer. It will take years of observations to accumulate the information which will enable accurate forecasts to be made, but the ultimate goal is to develop a dispatchership of streams similar to the dispatching of trains on a railway system.

The percentage method used in the measurements involves the searching out of representative areas in the high mountains, where the snow lies level and unmelted from autumn to spring; the measurement of depth and water content of the snow; and the computation of the seasonal percentage on the basis of an average covering several years. Following the snow measurements, which are made in late spring, the stream flows are measured in the ordinary manner. Also the early summer rains are to be taken into account.

The correlation between precipitation and stream flow will be gradually deducted as new data is collected, and this information should be of very great economic value.

Another Super-power Station

The steam generating plant at Golpa, Germany, from the begining was intended to provide the nitrogen fixation plants at Piesteritz with 500,000,000 kw-hr. of electrical energy a year and also to provide power for a large nitric acid plant in the neighborhood to the amount of half the above quantity, according to the Electrical World. The generating plant is located close to a lignite mine, cable cars taking the coal directly from the mine into the stokers. The daily consumption is 6,000 tons. There are sixty-four steam boilers, feeding eight steam turbines, each coupled to one 22,000 kva. generator of 6,000 volts and 50 cycles. After the shut-down of the wartime nitric acid plant the output from part of the units was taken over by the city of Berlin, the power being transmitted over a 78 mile, 110,000 volt line.

Women Engineers

An article in "Civil Engineering" (London) gives an interesting account of the formation and achievements of the Women's Engineering Society which was organized in England about a year and a half ago by the wife of Sir Charles Parsons,—inventor of the turbine. Lady Parsons thought it was a pity to waste all the new engineering talent developed among the women and girls in the munitions plants during the war, especially since many of the girls had grown to like the work. The society was formed to throw open to them the professional side of engineering. Through the society's efforts all the men's engineering associations, the Institute of Mechanical Engineers, the Institute of Electrical Engineers, and the Institute of Civil Engineers now admit women to membership, and the Universities and Technical Colleges impose no sex-barrier. The society has secured support from various interested people in a scheme for an engineering works to be run entirely by women. A plant was secured and is now being equipped for their purpose. They have already secured contracts to produce hosiery needles and the machinery parts of a newly-invented pump. The original employees will all be shareholders and the secretary and works manager, both women, will sit with the board of directors. They hope to develope the plant on a profit-sharing basis.

The U. S. Reclamation Work

The appropriation of $20,277,000 for the Reclamation Service, carried in a bill recently passed by the House of Representatives, will give a decided impetus to the magnificent work of this department which has been considerably curtailed for some time. According to the recent annual report of the Reclamation Service the net cost of all the reclamation work up to the end of the fiscal year 1919, was nearly 125 million dollars. The projects now under way or completed embrace about 3,300,000 acres of irrigable land. The value of the investment in reclamation work is not hard to see when one considers that the value of the crops produced in 1919 on land wholly within government projects was 89 million dollars. A million acres of land outside government projects was served by contract with water from the government ditches, and the total value of crops from all the land watered by the government projects is in one year almost equal to the total cost of the reclamation work.

Mine Products Bulk Large

The Mining Congress Journal for November prints some interesting figures on the mining industry as a whole. In the first three months of the present year figures show that 52 per cent of the carload freight carried by the railroads of the country consisted of raw materials from America's mines. For one ton of farm products 4½ tons of mine products were carried, and the mine tonnage totalled 2½ times all the manufactured products and 5 times all forest products.

Pulverized Peat Fuel

Pulverized coal has been successfully used since 1895, but pulverized peat is new to this country, although the process has been used in Sweden for several years. A successful experiment, carried on in Minneapolis with this fuel, is reported in the Journal of the A. S. H. V. E. for January. Wisconsin, with its great peat deposits, should be alive to this development.

Electricity Increases Farm Values in California

Electric service on farms is accredited with a large part of the six years' increase of $56,000,000 in land values in Tulare county, California. At the same rate, electric service on just one-fourth of the farms in the United States—the one-fourth nearest to present electric transmission lines—would increase United States farm values to $20,000,000,000, a sum nearly equal to the total of the five Liberty loans.

Beautifying Concrete Surfaces

An apparenty successful method of coloring and decorating concrete surfaces by the application of metallic salt solutions, using an ordinary hair brush, is the patented invention of Messrs. Sanders, two Dutch engineers. A sample of some of their work done in Holland three and one half years ago shows no signs of deterioration or loss of color. Furthermore the treatment is said to increase the strength of the material, for it penetrates the surface to a considerable depth, and also renders it impervious to moisture.

Walls covered with p'ain and molded cement asbestos-sheeting can be finished to resemble rare marbles and other stones. Coloring can also be produced to resemble copper, bronze, silver, or old wood. The surface can be waxed and polished to any degree of luster.

There appears to be a very large scope for the use of this invention in connection with new housing schemes. The objection to the use of concrete for houses, which is largely due to appearance, should be swept away

Characteristics of Russian Engineers

An article in Mining and Metallurgy for this month discusses the qualities of the native Russian Engineers. These men, who number about 40,000, are mostly the graduates of Russian schools, where they get first class education. The only disadvantage to which Russian technical men are subjected arises from the crowded conditions in the colleges. The Russian engineer, according to the writer, is characterized by his sensitiveness, ingeniousness, adaptability, and thoroughness. The work done by the engineers of that country compares more than favorably with that done by our own engineers, both in the field and in the industries up to the time of the Revolution. The Russian engineer is a hard worker, and, perhaps, more than any other, puts the convenience and consideration of man ahead of that of the animals and machinery with which he is working. The Russian technique shows distinct German influence, due to the close proximity of the latter country, but in any case those men who are going to compete with foreign engineers will find a worthy contender in our friend the Russian engineer.

A Self-Exciting Mercury-Arc Rectifier

A difficulty with ordinary mercury-arc rectifiers is their tendency to to go out if the load drops below a certain point. There has recently appeared in Germany a new kind of "self-exciting" rectifier which will continue to operate even if the load is completely shut off. The new rectifier type, according to Elektrotechnische Zeitschrift, is of glass, quite similar to current models, but is provided with two auxiliary anodes fed from a special winding on the input compensator. The winding has a mid-point tap which is connected to the cathode, and, in the auxiliary-anode connections, are inserted two resistors, so that the auxiliary system forms, as it were, a small rectifier within the power rectifier. This auxiliary rectifier system takes about 100 watts, is started in the ordinary way, and is always kept running. It, therefore, automatically excites the power arcs so that the main rectifier starts as soon as the direct-current output circuit is closed, and thus the rectified current is perfectly stable down to a very small current strength.

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"MIKE" GODDARD, ex-m '21, is working in the University Shops. He expects to resume his studies at the beginning of the coming semester. "Mike" was a hustler on our business staff, and we are looking forward to his return to our midst.

"LUKE" NASH, e '17, is in the Industrial Sales Department of the American Radiator Co., at 816 So. Michigan Ave., Chicago, Ill.

GEORGE A. RODENBAECK, e '05, is treasurer of the firm of Higgins & Rodenbaeck, 421 First Ave., New York City.

RICHARD A. RUEDEBUSCH, m '10, is a buyer for the Fred Rueping Leather Co., Fond du Lac, Wis.

OLIVER J. SCHIEBER, C.E. '12, is Production Engineer with the Southern California Edison Co., on construction of the Big Creek hydro-electric development, at Big Creek, Calif.

BERRY T. STEVENS, m '14, is western manager for Howland & Howland, publishers' representatives, Chicago, Ill. His home address is 6554 Kimbark Ave., Chicago, Ill.

E. H. VAN PATTEN, m '17, was recently married to Miss Irene Patnoe, a former student of Northwestern University. "Van" is with the Marland Refining Co., Ponca City, Okla.

WALTER E. WAHLE, ch '17, is on the engineering staff of the Root & Vandervoort Co., of Davenport, Ia., manufacturers of automobiles.

ROSCOE G. WALTER, c '05, is Assistant General Superintendent of the Wisconsin River Power Co.

J. L. WALTON, ex-ch '21, who has been out of the university since January, 1920, on account of illness, has recovered and is employed in the operating department of the Edison Lamp Works of the General Electric Co., at Newark, N. J.

FREDERICK C. WEBER, e '03, is manager of the Pioneer Oil & Refining Co., Chicago, Ill. His home address is 1452 Rasher Ave., Chicago.

E. L. WEILAND, ex-m '22, is assistant manager of a foundry at Milwaukee, Wis.

RALPH WILLIAMS, c '17, came in just before the holidays and left word that he is with the American Construction Company.

J. H. WOLFE, ch '12, is Superintendent of Gas Manufacture at the Spring Gardens Station of the Consolidated Gas, Electric Light & Power Co., Baltimore, Md.

W. R. WOOLRICH, e '11, was called to Mineral Point by the death of his mother. He stopped in Madison on his return to Knoxville, Tenn., where he is associate professor of mechanical engineering at the University of Tennessee. Mr. Woolrich is also a consulting engineer with the W. B. Briggs Engineering Co.

F. P. WOY, e '03, has been appointed lecturer in engineering administration.

R. M. WYATT, e '17, is assistant general superintendent of the Stevens-Duryea Inc., Chicopee Falls, Mass.

CAMPUS NOTES

By Frederick W. Nolte

SEMINAR STUFF

Nineteen juniors tried their luck at defining the word "sabotage". Five guessed it right; one refused to try it at all; the other 13 produced some rare ideas; among which were,

Pertaining to the Sabath (note the misspelled Sabbath)
Goods
A servant
Affiliation to a master
In reference to the bolsheviki
A breakfast food
Plunder
A holy shelter
A religious holiday

By a margin of 6 points, the swimming meet was lost to the Engineers on January 19, the victors being the L & S team. The high individual honors went to an L & S man, who took 9 points; H. E. Czerwonky, '24, engineer, took second honors with 8 points. The Engineers' relay team won first place, but there was not enough backing throughout to bring up our score. Let's get out, engineers, and win some of these interclass meets. We need the Nelson trophy for our lobby.

Dean Turneaure has been elected president of the City Y. M. C. A. for the ensuing year.

Over a Constantinople dispatch to the effect that Mustapha Kemel, the Turkish leader, had left for the front, the inspired head line writer of the State Journal puts,

"Must Alpha Kamel on
Hike for the Front."

Just enough Turkish to make it interesting. Like Omars, eh?

A one-fifths course in perambulation will be given to everyone taking a course in the new shops, according to Mr. Dabney. The shops will be ready for use next semester, for the pattern shop has already been moved and the foundry will go as soon as possible. The lecture room and pattern shop in the old building are being remodelled for use as an electrical laboratory.

Many rumors were floating around as to the purpose of the "big-top" on the lower classes. One rumor had it that the tent had been erected for an all-University meeting of the Wisconsin chapter of Shifters; another suggestion was the exhibition of the three great prehistoric animals, the Wow, the Wampus, and the Woofenpoof. Slide-rule investigated the matter and found that the tent was to house the mechanical exhibit to be used in the annual State Highway Commission Road Congress. It was learned that Music Hall would be used for the lecture work and that the tent would house the "apparati" that were sent here by the different manufacturing companies to demonstrate their wares. Later developments, viz: the arrival of the apparati, confirmed the first suspicions. A large portable rock crusher, a caterpillar-tractor, concrete mixer; motorized road scarifiers and scrapers; and two-wheeled dump carts are included in the exhibits. County highway men from all over the state will assemble here to learn the latest developments in road construction, maintenance, and administration, and to tell others what they have done in their territories.

I KNOW WHAT YOU WANT ME TO SAY, BUT MOTHER SAYS I MUSTN'T USE THAT KIND OF LANGUAGE

Mr. Miller walked up the hill just ahead of a student and a co-ed and heard the latter pour forth a tale of mental anguish to her escort. Says she, "I have two different engagements to go to different dances, at different places, with different fellows tonight. Oh, dear! Oh, dear! What shall I do?" "Far be it from me to tell you what to do in such a desperate case," replied her companion, "but I have a suggestion. Call up man number one and tell him you will go with him from nine to ten thirty. Then call up the other man and tell him you will go with him from ten thirty to twelve. If they are the right kind of fellows they will tell you what to do."

Professor McCaffery has just received a French patent dated August 3, 1920, covering his invention of a basic bottom to be used in an acid bessemer converter.

Have you noticed that there has been a Dodge touring car missing from the back yard of the Engineering Building within the last two months? Mr. Beebe tells us that his car was stolen from in front of the gym a short while ago, and that he has just received the insurance on it.

Sliderule says he may have won the girl with the car and then lost the car to collect enough money to marry the girl on.

Just before the close of the semester Professor Bennett was called to Jeannette, Pa., by the death of his mother.

The new, million-pound testing machine, recently erected at the Forest Products Laboratory, at Madison, is described by L. J. Markwardt, c. '12, in the Engineering News-Record for January 6.

Instructor in foundry told a frosh to get the swab to moisten the pattern before withdrawing the mold. Dutiful frosh returned with a sprinkling can and soaked down the sand, greatly to the disgust of the instructor.

THE CRAFTY LANDLORD

Having been forced to comply with a request for a small stove on the third floor, a crafty landlord bethought him of a scheme to save fuel in spite of the stove. Under cover of darkness the little man, with a volume of Sears and Roebuck under his arm, crept stealthily up the stairs to the stove. Quickly he took down a section of pipe, stuffed it with paper, and returned it to its proper place. The first cold weather demanded a fire, but the stove wouldn't draw. The reason was soon discovered and the plug removed. The landlord was foiled for a moment, but he still had an ace in the hole. The next morning he appeared with a can of paint and very solemnly painted the handle of the coal shovel.

COMPARISON OF PROM EXPENSES

First Prom Goer.		*Second Prom Goer.*	
Dress suit	$80	Dress suit	ditto
Cab and incidentals	$30	Cab and same incidentals	ditto
Engagement ring	$200	One dozen lemons	$.50

Prof. Kolwalke please note.

"Eutechtoid—A solid solution of two metals which are insoluable in each other." A definition given in Metallurgy by Rolly Soll.

The late Professor Shealy was, at one time, an instructor in the steam and gas laboratory. He used to say that the lecture system was the most painless method known for conveying information to students, and, in support of the statement, he would tell the story of a lad from one of the southern states who came to him one hot day near the end of one of the summer sessions and said, "Professor, I have one more experiment to do in this course. It is very hot in that laboratory and I would like to complete the requirement in some other way than by doing that experiment. How would it be if you would lecture to me for an hour?"

Wouldn't it be kinda spring like, along with the other evidences of spring we are having this winter, to see frosh out in their verdant headgear?

JANDORF

I read about the Lynaugh case and then I grabbed my hat and led myself a merry chase to where an old friend sat. I found him in a lecture room; he is an ancient prof. I cried, "Old friend, I dread your doom; you'll soon be fozzled off. You're like an unprotected cat amongst these studes—wild eyed. Oh, surely you should tote a gat to save your poor old hide. I read the papers and I'm told that even cops must kill to save their lives from rowdies bold who hang out on the Hill. And if a corn-fed cop must shoot when handling this gang, pray how much chance have you,—poor coot—a meek, moth-eaten man?

He took the specs from off his head and wiped them leisurely. "Take one good look around," he said, "and tell me what you see. You see a lot of girls and men whose middle name is work. It isn't hard to handle them, —I never use a dirk. All lethal weapons I eschew; I'd hate to have a fuss; I'd really not know what to do. Why I can't even cuss. And yet I make these students wild, behave from dawn to dark. I never have to kill a child to make him toe the mark."

I took my lid and came away and left that ancient prof. I know he'll live for many a day when I have shuffled off. He doesn't cuss nor wield the rod; he is a man of books; and yet he seems to boss that squad that Clancey says are crooks. Perhaps the stude is not so tough. Perhaps he has a soul. To kill him seems a trifle rough to save a barber pole.

MALT BASIN

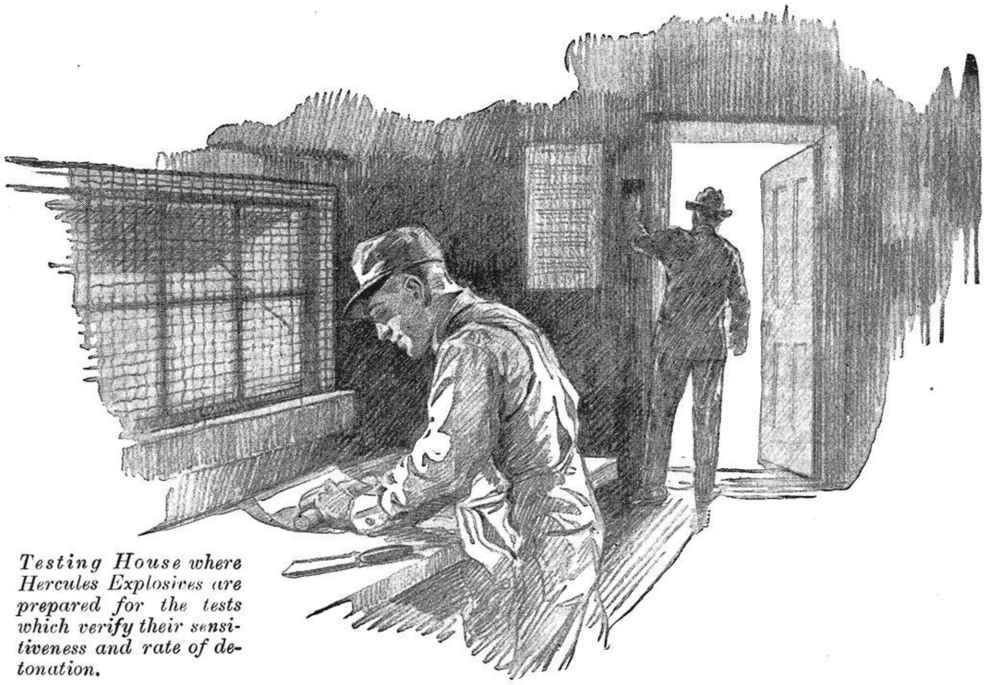
THE ENTERTAINING STORY OF THORKELSON AND HIS PET

Mr. Thorkelson, business manager of the university, was safely domiciled for the night when in blew Professor Phillips and wife for the evening. "Whist", said Torky, as the women folks passed the time of day, "Come into the cellar, I have something to show you". Professor Phillips came with alacrity. That's the word, —alacrity. "There", said the business manager, as he opened a door and led the way into the secret compartment, "what do you think of my new furnace?"

* * *

The new furnace is a wonder,—double-jointed, automatic, self-cleaning, and burns soft coal. "Do you have any trouble with it"? asked Phillips." "None whatever," says Torky, "Of course, sometimes gas collects and I nearly kill the family when I feed the hopper; but I think that can be fixed. Also gas collects in the chimney at times and blows out. I blew soot all over a fresh wash in the laundry one morning, and all over the breakfast that was on the stove in the kitchen above. But that's all". "What did the wife say about that?" asked Phillips. "Not a word. I was in a hurry and wasn't very hungry anyway, so I slipped out the side door and came down to the office."

Are you a shifter?



Testing House where Hercules Explosives are prepared for the tests which verify their sensitiveness and rate of detonation.

The Testing Ground

In every high-explosives plant of the Hercules Powder Co. the *testing* of dynamite plays an important part in the day's work. Just as the most modern and efficient dynamite machinery is never considered infallible; just as the simplest and most obvious process is never taken for granted; so the accuracy and uniformity of the finished product is never conceded without complete verification.

Every lot of dynamite, after it has passed the chemical laboratories, must be tested repeatedly for sensitiveness by actual explosion before it is shipped. Upon the men in charge of this important work at the Testing Ground depends, in no small measure, the uniformly high quality of Hercules Explosives.

It is because of this constant testing—this skillful verification of quality—that, wherever Hercules Explosives are used—in blasting out a stump or a mountain, in diamond mines or stone quarries, digging a ditch or changing the course of a mighty river—their power can always be depended upon by those who seek their aid.

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