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DESCRIBES EXPO

Containing articles pertaining to two of the most interesting exhibits at the Exposition, the April number of the Wisconsin Engineer comes out very opportunely while the Exposition is in progress. The leading article is a non-technical write-up of the Forest Products laboratory telling in an interesting manner of the research work on wood and wood products carried on at that institution. Among the illustrations is a picture of the hexagonal drum box testing machine invented at the laboratory. Following is the fourth and last article by Prof. Max Mason on his submarine detector, a model of which is installed in the swimming tank in the gymnasium, as a part of the ex-

hibit of the Physics department. Another article on concrete ships gives a very complete survey of the problem of outfitting a concrete ship so as to convert the bare hull into a complete ship.

The St. Patrick's day parade passes into written history by way of a write-up which surpasses even the Octopus for humor. A good discussion of the question of licensing engineers follows, and the editorials, campus notes, and alumni notes add the finishing touches required to make an unusually interesting issue. Copies of the Engineer will be on sale at the Exposition near the submarine detector exhibit, as well as in the engineering building.

COLLEGE HUMOR

SOMEONE once said that a man's character is judged by the kind of humor he approves or disapproves. Today the character of the University of Wisconsin is not only being judged, but it is also being analyzed, estimated, accredited, and rated according to the type of humor which is making itself evident in campus publications.

The Cardinal agrees with the Wisconsin Engineer that "when campus wits can think of nothing more humorous than a play of words of two meanings—which one must morally distort and then call humor, they might better refrain from writing. Such task is not humor, it is a reflection on Wisconsin."

Students have been loath to criticize this state of affairs, but have endorsed efforts that have been made to improve the character of the humor that appears in student publications.

It would indeed be a sad commentary on mental resources of students if we should be obliged to confess that nothing in college life is funny unless it has a strong tendency to be risqué.

The student publications which have been guilty of giving currency to even slightly shady reading matter labelled humor are in a fair way to injure themselves by making it necessary to institute more rigorous censorship than now prevails. A tightening of the screws by the censor is a disagreeable process to institute at this time, but a continuance of the present tendency will bring about such a result.

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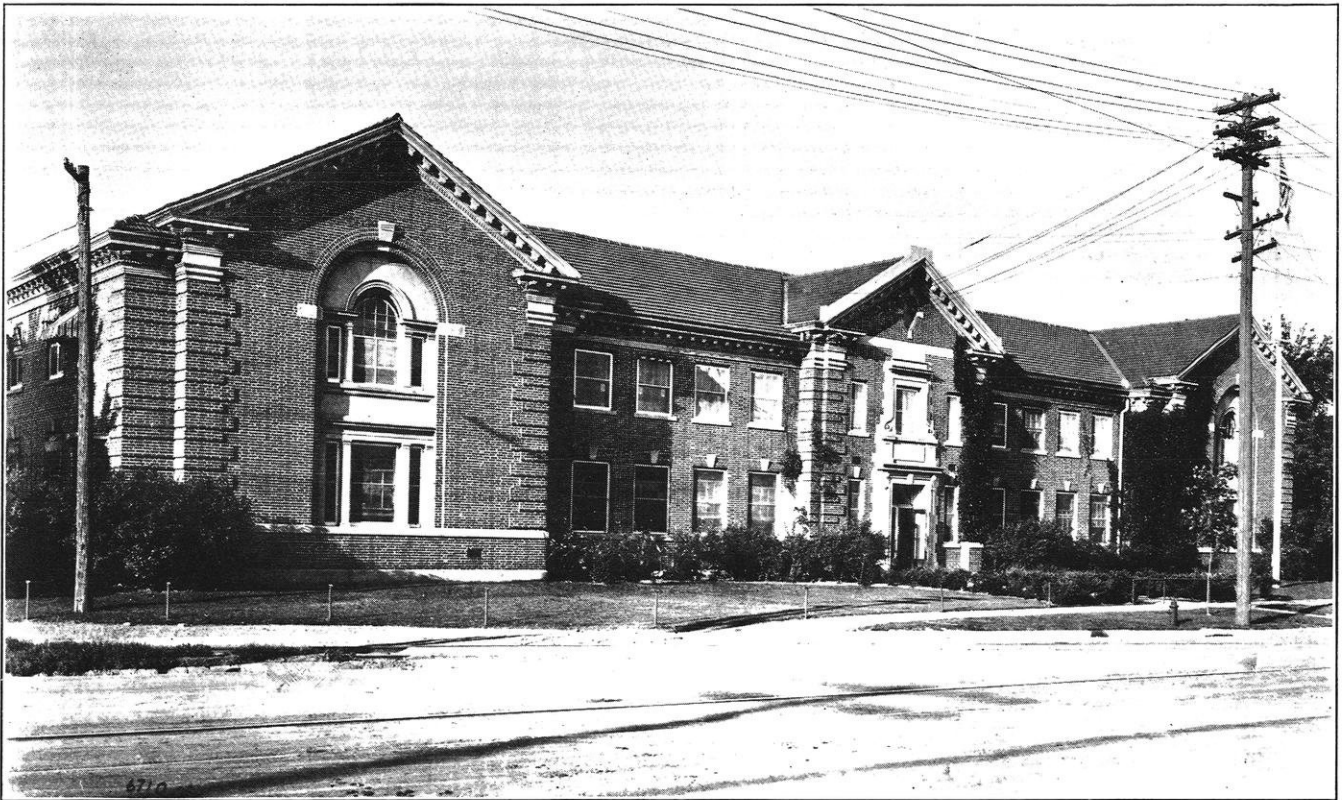
The WISCONSIN ENGINEER

Published by the Engineering Students of
THE UNIVERSITY OF WISCONSIN

VOL. XXV

MADISON WISCONSIN, APRIL, 1921.

No. 7



THE FOREST PRODUCTS LABORATORY AT MADISON, WISCONSIN



The WORLD'S WORD for
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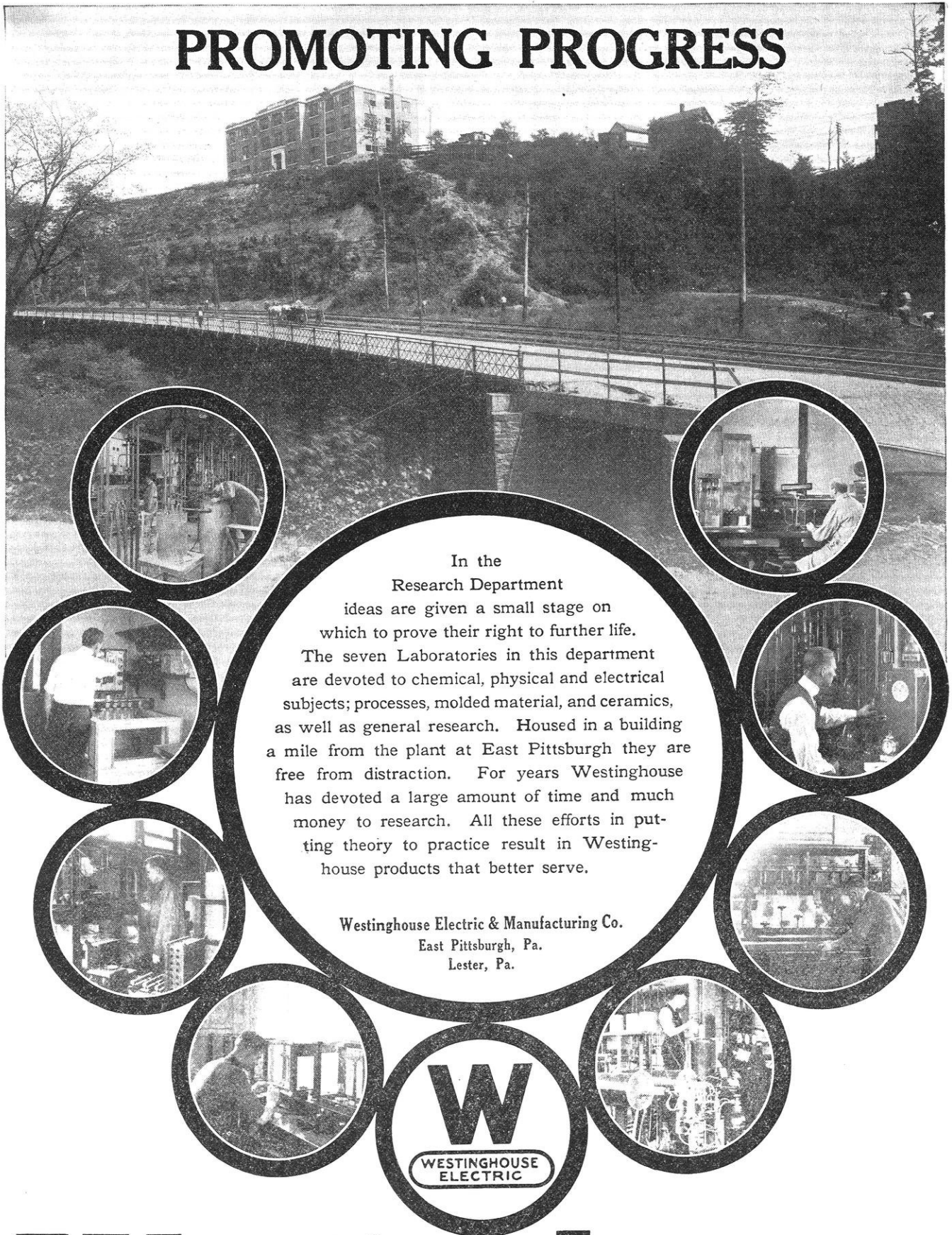
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UNIVERSITY OF WISCONSIN

VOL. XXV, NO. 7

MADISON, WIS.

APRIL, 1921

INDUSTRIAL RESEARCH AT THE FOREST PRODUCTS LABORATORY

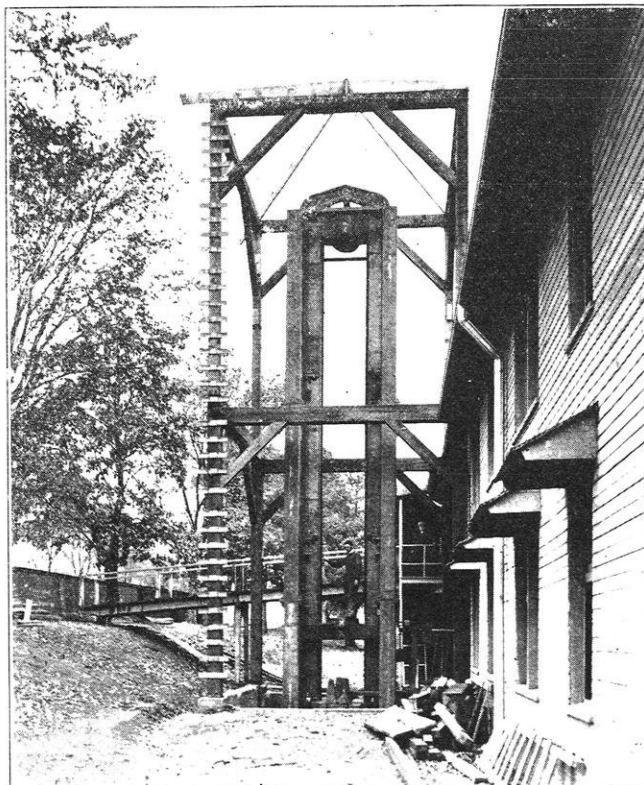
BY KENNETH L. SCOTT
Senior Electrical

The Forest Products Laboratory came into being over ten years ago in response to the need for more authoritative and complete knowledge of the properties of American woods and the uses for which they were best adapted. And it is because of the success of the Laboratory in solving the problems and answering the questions of the wood-using manufacturer that organized research has, in the past decade, become more and more clearly recognized by the wood-using industries, not only as a paying investment, but as an actual necessity. Organized industrial research, as carried on at the Laboratory, is not the type of research at which the average engineering student has been wont to shy in the past, for it is intensely practical. Its investigations are conducted, not solely to add to the sum of human knowledge, although such research is by no means to be despised, but rather its aim is the solution of manufacturing problems, the development of processes that pay, and the discovery of means that will increase the utility and decrease the waste of our forest products.

The Laboratory is a federal government institution. It was founded in Boston, moved to Washington, and later brought to Madison, where it is conducted in co-operation with the University of Wisconsin. At its head is a director, under whom it is organized into several research sections and the sections of Laboratory Operation and Publication of Results. The latter sections relieve the technical men of clerical work and routine administrative duties, thus enabling them to devote practically all of their time to the technical or scientific work to which they have been assigned. The research sections consist of the sections of Timber Mechanics, Wood Preservation, Timber Physics, Pulp and Paper, Derived Products, Industrial Investigations, and Wood Pathology. The names are, for the most part, descriptive of the activities of the sections. The work of each section is divided into projects. Each piece of work that can be isolated sufficiently is called a project, and is assigned to one or more of the staff. The projects that are undertaken by the various sections cover such a large range of investigative subjects that it is difficult to select suitable examples as illustrative of the work of the Laboratory, but in the following paragraphs an attempt will be made to give a general idea of the methods employed and the problems attacked by means of some of the most interesting features of the work of each section.

Timber Mechanics

The section of Timber Mechanics, as its name implies, is concerned with the mechanical properties of woods and of various structural members made of wood, such as airplane wings, wing ribs, wing beams, and girders. The laboratory in which the testing is done, commonly known as Timber Test, is like the mechanics laboratory of the Engineering college, but it is larger and its work is confined to wood. All of the standard tests, such as static bending, impact bending, shear, compression, and hardness, and a great many special tests, are made on wood and wooden members. In all, over 500,000 strength tests have been made here on all sorts and sizes of specimens. The latest addition to the array of testing machines is a 1,000,000-lb. Riehle machine for testing large structural timbers, such as bridge stringers. This giant machine is housed in a special tower, forty feet high, and it looms up among the other machines like Gulliver among the Lilliputians.



THE MILLION POUND TESTING MACHINE AT THE FOREST PRODUCTS LABORATORY. This machine is used for testing full sized structural timbers such as bridge stringers and building columns.

Another interesting feature of the work of Timber Mechanics is the box laboratory. In the transportation of commodities in the United States, the daily loss due to faulty or poorly designed containers, improper packing, or pilfering, amounts to a tremendous sum of money. Much of this loss is preventable, and it is the aim of the box laboratory to assist in reducing this daily loss by developing more efficient shipping containers which will carry their contents to their destination in a satisfactory condition and at a minimum cost, all things considered. The first step in correcting a fault is to locate the fault. Hence the hexagonal box testing machine was invented at the laboratory. It is a drum fourteen feet in diameter and can accommodate containers up to four feet in diameter and 1,000 pounds in weight. The six sides of the drum are studded with knobs, corners, and baffles. As the drum slowly revolves the box falls on these, striking on its sides, corners, and edges, thus simulating the actual conditions of rough handling. As the box falls on successive faces of the revolving drum an automatic dial records the number of falls or "drops." A trained observer sits at the side of the drum and records the points of weakness as they are developed, and the number of drops to produce such failures as splitting of the sides, loosening of the nails, breaking of the straps, and finally, complete failure and spilling of the contents. As a result of such tests, it has been possible to recommend changes in the construction of boxes and crates which have saved many firms immense sums on shipping and packing.

The importance of correct nailing is another matter which has often been neglected. As a result of long series of observations of failures due to inadequate nailing, the laboratory has been able to issue box nailing schedules giving details as to sizes and spacings of nails to be used under various conditions. Most of the native American woods have undergone test in the hexagonal drum.

Wood Preservation

It is the endeavor of the wood preservation laboratory to determine the effectiveness of different kinds of preservatives,—mainly creosote, zinc chloride, and sodium fluoride—the depth of penetration necessary to secure best results, and the correct temperature and pressure for properly treating each species. The wood treated at the Laboratory is put into actual service. Laboratory treated ties are in use in parts of the tracks of a large number of railroads. Fence posts have been widely distributed for tests. There are poles in electric lines near Los Angeles, Cal., Buffalo, N. Y., and Savannah, Ga., which were treated by laboratory methods. Annual inspections are made of these test specimens.

This section also carries on exhaustive tests of glues and their use in the furniture, veneer, vehicle, airplane, and allied industries. Along with its glue studies the Laboratory has done much work on laminated wood construction. The advantages of this type of construction are many. Large blocks of wood, free from defect, are becoming increasingly hard to find. It is much easier to

dry the thinner pieces, and the time of this process is cut to a minimum. Laminated articles also mean economy of lumber, since pieces of wood which were heretofore considered waste can be used in many ways. Various laminated articles have been successfully tested. The University of Wisconsin baseball team used laminated bats all last spring. Some of the bowling pins turned out at the Laboratory have weathered successfully over 1,700 games on one of the Chicago alleys. Shoe lasts, hat blocks, duck pins, and many other articles have been successfully tried out by commercial firms in various parts of the country.

Great strides in the development of laminated wood were made in the study of airplane propellers by the Laboratory. In the propeller laboratory there are propellers of nine different species of wood, some scarce and expensive, others cheap and abundant. It has been found that all of these species, including red gum, can be manufactured into propellers with slight tendency to warp, and if they have the required strength, will permit cheaper and easier production of propellers.

Timber Physics.

Probably the outstanding feature of the activities of the section of Timber Physics is its work on experimental and applied kiln drying, but in addition it is engaged in investigations of the physical properties and structure of various species of wood, and their identification.

Wood-using industries in all parts of the country are acquainted with the advances the laboratory has made in recent years in the field of kiln drying. In order to achieve and maintain a place with the leaders in the knowledge of kiln drying, a great number of experimental kiln runs have been necessary. To this end, six kilns have been working almost continuously, night and day, since their erection. The drying of the lumber goes on silently, mysteriously, with no grinding of machinery, yet the kilns are a constant source of interest to the visitors at the Laboratory. When first built, all six kilns were of the water-spray type. At present five are still operating as water-spray kilns, but one has been changed to include new combinations of apparatus conforming to new ideas evolved by the laboratory staff.

In the water-spray type of kiln, partly saturated air passes over the wood to be dried, extracting moisture therefrom and becoming more nearly saturated. The current of air then passes down the side of the kiln through jets or sprays of cold water. The sprays cool the current of air to such an extent that it promptly loses part of its load of moisture to the pit beneath while baffles remove any mist or spray. The air passes on over steam heated pipes, is warmed, its power to absorb more moisture is thus restored and it continues again around the circuit. The sprays of water thus serve a two-fold purpose. They keep the air in the kiln in circulation, and they act as a condensing agent for the saturated air.

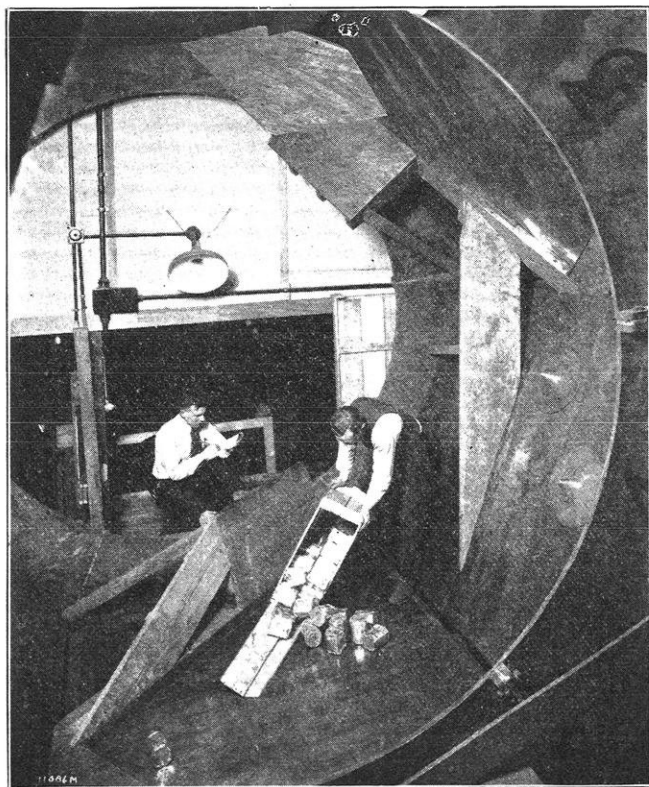
With the results of extensive experiments as a guide, it is the aim of the Laboratory to co-operate with industrial firms which are having difficulty in drying wood,

and to enable them to establish satisfactory methods and schedules. Recently a certain concern was able to save at least three hundred dollars a day and keep its plant from being shut a part of each week by following advice received in free consultation with one of the staff.

All federal work in the identification of species of wood is carried on in the laboratory of wood technology. Samples are received from all parts of the country for identification, and, with the increasing importation of foreign woods, a large number of the samples submitted are from foreign trees. As an aid to this work of identification, a collection has been built up including nearly 7,000 wood samples from all parts of the earth. Frequent disputes between buyers and sellers of wood concerning the exact kind of wood ordered and the kind delivered are settled by identification here.

Pulp and Paper.

The Pulp and Paper section of the Laboratory contains complete equipment for converting logs into any desired grade of chemical pulp and subsequently into



THE BOX TESTING MACHINE. *The drum is 14 ft. in diameter and can accommodate containers up to four feet in diameter and 1,000 lbs. in weight. As the drum revolves, the container falls on knobs, corners, and baffles, until failure occurs.*

paper. The Laboratory is devoting a large part of its time to a study of the suitability of the more important American woods for the manufacture of pulp and paper. One of the most important phases of this work is a thorough investigation of the causes and means of prevention of decay of wood pulp, which is estimated to cause an annual loss of \$5,000,000.

During the war extended experiments were made at

the Laboratory to determine the proper means of treating wood pulp to make it suitable for the production of nitro-cellulose, an essential ingredient of explosive shells which had heretofore been derived from cotton. As a result of those tests, the Du Pont Powder Company made 100,000 pounds of smokeless powder from wood pulp. This powder met satisfactorily every test to which ordinary nitro-cellulose made from cotton is subjected.

The operation of the miniature paper machine is very interesting. The rollers turn out a strip of paper sixteen inches wide at a speed of forty feet a minute, which is quite suitable for experimental purposes, although not comparable to the large paper mills whose rollers have a maximum speed of nearly a thousand feet a minute.

The Laboratory recently investigated the making of paper out of cotton linters. It was found that cotton linters make a high grade of paper, and as a result of the Laboratory's tests two large companies are now erecting plants for this purpose, basing their plans largely on the experimental work which has been done at the Laboratory.

Derived Products.

This section is occupied with the development of commercial products which may be obtained from wood by chemical treatment. One of the latest triumphs of the staff of this section has been the discovery that sawdust from certain kinds of wood, when properly treated, makes an excellent food for cattle. The laboratory men call the sawdust feed "hydrolized wood". It is a mixture of sugar and chemically treated wood obtained by cooking the sawdust with dilute acid. The dairy department of the University was requested to co-operate with the Laboratory to determine the food value of this product. The feeding experiments were conducted under the direction of Professor Morrison of the University. Hydrolized sawdust was substituted for part of the barley feed and after a three months' trial the cows had actually gained in weight while the quantity and quality of the milk was unchanged.

Carrying the process of hydrolizing wood on through the next step, that of fermentation, has been found to be an excellent way of obtaining ordinary grain alcohol. Soft wood sawdust, such as is obtained from longleaf yellow pine, is best for this purpose because it contains the greatest proportion of that required ingredient, sugar. Commercial application of this method of producing alcohol means an immense annual utilization of waste wood.

Industrial Investigations.

The work of this department embraces the methods and practices in the lumber industry, lumber grades, lumber specifications, and mill scale studies. These items, while of no less value than the work of the other sections, necessarily present fewer features of striking interest because of their statistical nature.

Pathology.

The scientific study of the causes, growth, and prevention of decay is the field of the section of Pathology. Decay is produced by a fungus which attacks some kinds of wood much more readily than others. These fungi

are considered as plants which, when provided with suitable conditions of moisture, temperature, and food, thrive and produce in the wood the effect known as decay or rot. There are several methods for controlling the attacks of fungi. Reducing the amount of moisture in the wood decreases the ability of the fungi to grow. Wood preservatives can be used which destroy the food supply of these agents of decay. Sanitary precautions in shipping and storage often prevent rotting. Some fungi are killed by heat. A successful experiment was made on a mill building in which decay had attacked the beams. By raising the temperature of the building at four different times to 115 degrees Fahrenheit, most of the decay was stopped.

Making the Results Available.

After the desired information on any subject has been obtained, as briefly outlined in the preceding paragraphs, it remains to make this information available for public use. To this end, as the work continues, and when it is completed, reports are written. Ultimately all the results of value are published, either as bulletins or circulars by the Government, in technical notes, by correspondence, or as special articles published in trade journals and in technical and scientific papers.

Co-operative work is frequently carried on between the Laboratory and individuals or companies using wood,

who are commercially interested in developing new or better processes or products.

Two short courses of instruction are given at frequent intervals at the Laboratory, one in kiln drying, and the other in boxing and crating. These courses are of particular value to superintendents, lumber and production men, and foremen in wood using plants. The instruction is under the supervision of a staff of competent specialists and the enrollment is limited to twelve men in each course, so that proper attention may be given to individual problems. Priority of application governs admission to the courses, and the classes are usually filled for two or three months ahead of the schedule.

In the attempt to show what practical industrial research is like and how it is conducted upon a large scale, the foregoing description has, of necessity, touched upon only a few of the many valuable contributions of the Forest Products Laboratory to the wood users of America. The total value of this research cannot be estimated although in many cases the results of an investigation can be translated immediately into terms of a definite saving in dollars and cents.

An interesting demonstration of the Laboratory's activities will be found at its exhibit at the University Exposition this month, and for those whose interest does not stop there, the Laboratory is open to inspection at any time.

SUMARINE DETECTION BY MULTIPLE UNIT HYDROPHONES

By MAX MASON

Research Professor of Mathematical Physics

Installation and Use of the M-V Tubes.

An idea of the outboard part of the M-V tube is given by Figures 12 and 13. In Figure 12 the receivers are shown attached to the ship, before the protective blister was mounted. Each receiver is itself multiple and consists of a cluster of rubber tips, whose outputs are immediately joined. A steel tube transmits the sound from each cluster to the compensator within the ship. These tubes pass through a stuffing box at the center of the line of receivers and are all of equal length, this equality being produced by adding loops of proper length. Correctness of length, which is of the greatest importance for the successful operation of the device, was tested by acoustical means before the tubes were mounted. The entire outboard assembly was given a vacuum test for leaks.

The type of receiver formed by clusters of rubber tips was much superior for use in a multiple unit line to any other developed, although many attempts were made to obtain a single receiver which would function as well as the cluster. Receivers could readily be made which gave a loud response when used individually. But this was always accomplished at the expense of phase-following ability. They were loud because of resonance, and, when used as members in a multiple unit device, produced

responses which were differentially out of phase with the exciting sound wave, and so failed to combine properly.

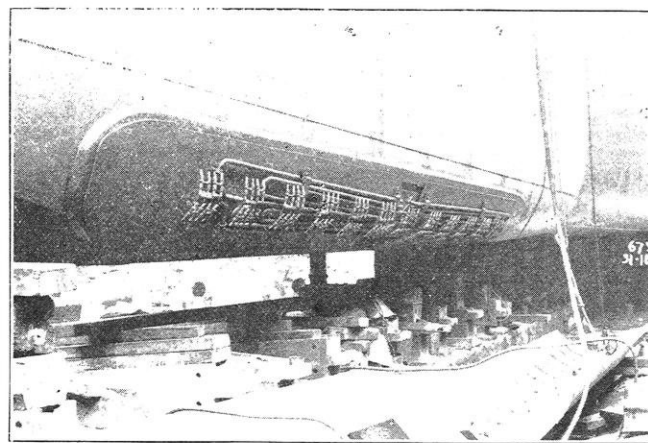


FIG. 12. OUTBOARD RECEIVERS OF THE M-V TUBE. Each receiver is a cluster of rubber tips. The sound from these is transmitted to the compensator through steel tubes.

A line of such receivers showed a very poor focusing action. A pair of resonant receivers does not give a good binaural effect, but so great is the adaptability of the ear that the binaural effect is not so much disturbed as the maximum, and many receivers which gave a very good binaural center when used in pairs were too resonant for use in the M-V line.

EDITOR'S NOTE. This is the concluding article of the series by Professor Mason.

An interesting comparison of highly damped receivers with more sensitive and resonant ones was made in the early *Narada* installation, where the receivers were of the metal diaphragm type. After the *Narada* lines had been mounted, it was found that water had been allowed to drain into the small chambers behind the diaphragms.

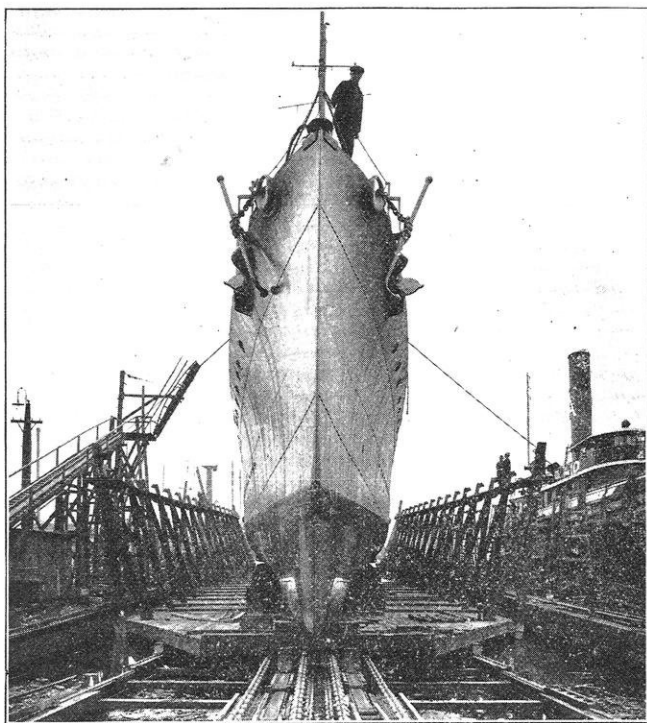


FIG. 13. BOW VIEW OF THE U. S. S. BLAKELY EQUIPPED WITH BLISTERS. The blisters are the receivers of Figure 12 with protective coverings.

This suggested the admission of water into the cavities as a means of damping the diaphragm motion. The comparison of a water damped line on one side of the ship with a line of dry receivers on the other side clearly showed the superior focusing action of the non-resonant receivers and the greater range and freedom from dis-

ing booth, a small compartment with sound proof walls, directly above the keelson and at the middle of the lines. The connecting tubes were held on sound-insulated mountings, and the compensator was supported on a sound-insulating spring suspension of a type devised by Professor Bridgman. Communication with the bridge was furnished by a voice tube.

The installation of an M-V tube on a destroyer was done normally in about a week's time. They were usually put on in the Navy Yards. After the device was made standard equipment for destroyers outfitting in the United States, the writer was sent to England. The test of a blister M-V resulted in its adoption for our destroyers based abroad. With facilities furnished at its dock yards by the British Admiralty, installation of the M-V apparatus on American destroyers proceeded with rapidity.

In case listeners trained at the New London Listeners School were not available, the radio men were generally called into this service and almost always made good listeners in a short time. Acuity of hearing was not so important in a listener as general intelligence and good judgment.

No general statement as to the range of detection of a submarine with the M-V tube can be made, as this varied so largely with the type of submarine and its state of repair as well as with the condition of the sea and the speed of the listening ship. A carefully tuned up submarine running at its predetermined most silent speed made very little noise and could be heard at most but a few hundred yards. The "silent speed" was, however, very low, from two-thirds of a knot to a knot and a half, and such low speed made the submarine very liable to destruction by depth charges. The submarine commanders usually attempted to escape by higher speed, in which case the sound from their engines became much greater, with a great increase in range of detection. A submarine running at four knots could be accurately located under favorable weather conditions at two thousand yards

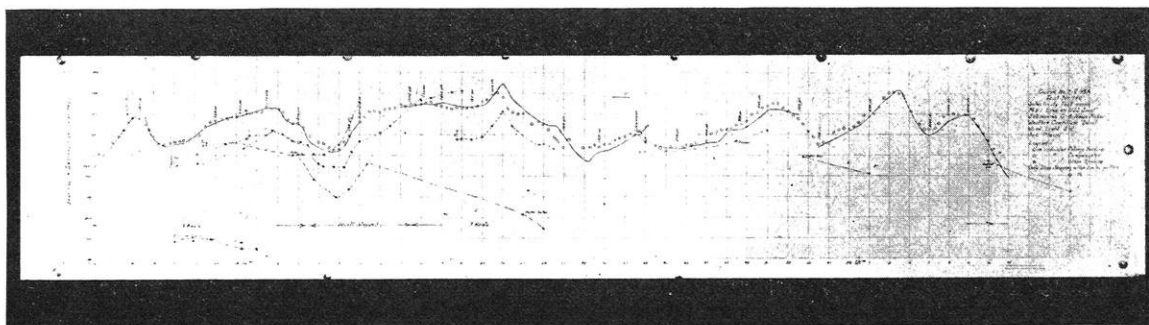


FIG. 14. RESULTS OF A TEST OF AN M-V TUBE. The small circles show the position of the submarine as located with the M-V tube. The full line shows the actual course of the submarine. Other lines indicate bearings of other shipping.

turbing noise of the line formed from them. Rubber tip receivers of proper dimensions were naturally damped to a sufficient degree to function successfully.

The compensator, the development of which was described in the March *ENGINEER*, was placed in the listen-

ing booth, and if the submarine's speed was increased to seven or eight knots, the range of detection became very much greater. Surface ships could be heard at considerable distances; destroyers ten or twelve miles away have been detected and accurately located from a de-

stroyer making fourteen knots. In freedom from water noise due to the ship's motion, the blister M-V exceeded all expectations.

The selectivity of the device is shown by Figure 14, which gives the result of a test run with a submarine. The test was for selectivity and not for range. The submarine, with motors turning at 140 r. p. m., was very clearly audible at 2400 yards with the listening ship, the *Jouett*, under way at seven knots. The object of the test was to see if the submarine could be followed

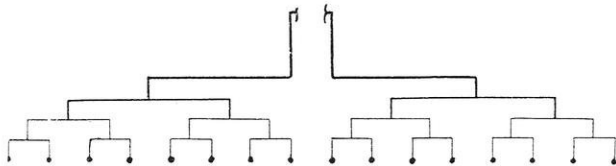


FIG. 15. PRINCIPLE OF THE M-V TUBE. In this instrument compensation is accomplished by rotating the line of receivers until it is perpendicular to the direction of travel of the sound wave. The sound is then binaurally centered.

in the presence of other shipping. Ordinates on the chart indicate angular bearing of the submarine from the *Jouett's* bow. The heavy continuous curve gives the bearing of the periscope as accurately observed from the bridge. The circles are the bearings obtained from the M-V tube. The bearings of other ships are given by the other curves. It is seen that the direction of the submarine was continuously determined with accuracy, even though other ships were on almost the same bearing.

Captain R. H. Leigh, head of the Anti-Submarine division of our Navy in European waters, reported on the blister M-V tube: "This is the best listening device, with which I have had experience, for destroyers. It is selective and accurate as to direction determining. Due to its selectivity it is remarkably free from the interference of shipping in its vicinity." In a letter to the Secretary of the Navy regarding the Naval Experiment Station, Admiral Sims stated: "Probably the most noteworthy development at New London has been the M-V

apparatus, escaped collision on two separate occasions by the listener reporting bearings of vessels before they could be seen. Its use when navigating in a fog is self evident."

The M-B Tube.

The apparatus described above was developed for use in a ship under way. The advantages of a multiple unit focusing device can be obtained in a simpler manner, if listening is to be done from a stationary ship, by mounting a line of receivers on a horizontal arm which may be rotated about a vertical axis. The principle of such a device, known as an M-B tube, is illustrated in Figure 15. The small dots indicate individual sound receivers. The length of path to be traversed by the sound from each receiver to the ear is the same for all receivers. The figure indicates the method of tube collection devised to accomplish this in a simple manner. In the diagram the collecting tubes are indicated by lines which are successively heavier, corresponding in the instrument to larger tube sizes. If the cross sections be conserved the pulses at each joining point pass undisturbed towards the ear end of the tubes, without reflection back towards the receivers. If reflection at the junctions took place, a standing wave system would be set up in the tube and the focusing action impaired. Such a line is in fixed compensation for a sound which comes from a direction at right angles to the line, or is "beam compensated." The line is mounted horizontally and is capable of rotation about a vertical axis, and direction is determined as in the M-V tube by a combination of maximum and binaural centering, a dial graduated in degrees giving the reading. In regard to binaural centering, it operates as does the simple instrument consisting of a pair of receivers at the ends of an arm, known as a C Tube, which was produced by the General Electric Company, and which was mentioned in an earlier section. After the multiple unit principle had been tested in the first M-V tube, its application to a rotating device was made in experiments by Professors Wilson and Zeleny, who arranged receivers in a vertical plane over a rela-

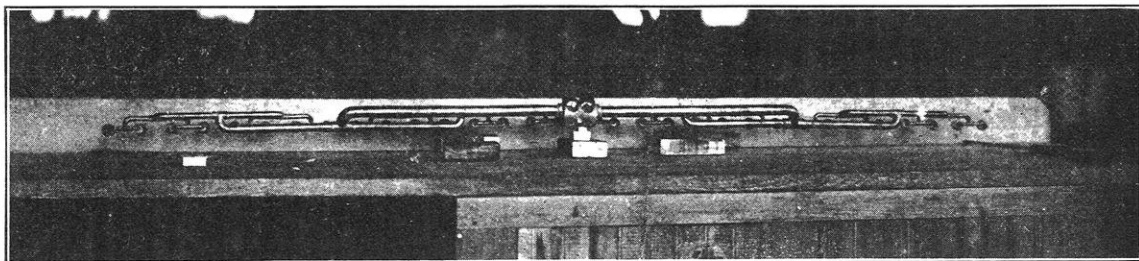


FIG. 16. SOUND COLLECTING TUBES OF THE M-B TUBE.

apparatus, which has proven in service that listening could be carried out in exceptional cases with the listening ship making twenty knots. This device is considered the best developed by any country for use under way, and this belief is shared by the British officers as well as our own. This apparatus has proven its utility as a navigational instrument as well as a means of detecting submarines. On one night the *Parker*, equipped with M-V

tively small spread with equal leads to a pair of collecting cones. The writer and his colleagues, in developing the M-B tube, went back to the distribution on a line as in the M-V tube to cover a wider spread of wave length of sound and to secure real focusing action. The collecting tubes of the horizontal arm are shown in Figure 16. These were made of copper, the tube assembly being slipped inside a protective tube. The receivers were

moulded, button-like forms which contained a cavity and an outlet, and were mounted in depressions bored in the protecting tube, so that they were flush with its side. The vertical rotating column, which contained the two acoustic tubes from the two halves of the line, was carried in a larger vertical pipe inside the ship. The rotating column could be raised and clamped so that the horizontal arm

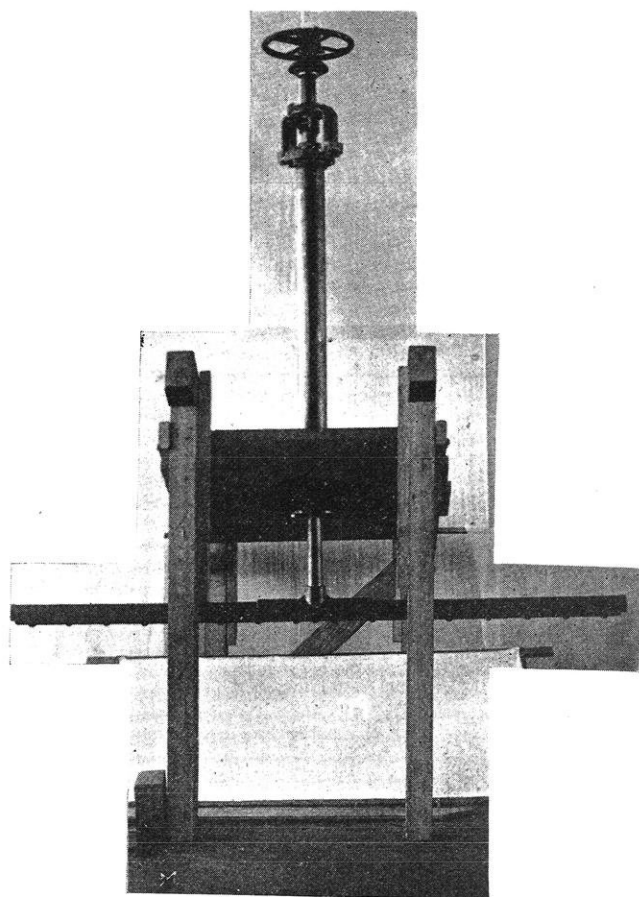


FIG. 17. THE OUTBOARD INSTALLATION OF THE M-B TUBE. The tubes of Figure 16 are mounted in the horizontal arm, which may be rotated to obtain binaural centering. When not in use, the instrument is drawn up into a depression in the bottom of the ship.

lay fore and aft in a housing against the bottom of the ship when the ship was under way. With the ship stopped for listening the column was lowered, and rotated by a hand wheel. The mechanical features of the vertical column were adopted from those of the C tube. The complete instrument is shown in Figure 17, the tube being shown in a partially lowered position. The horizontal arm is eight feet in length.

The submarine chasers were all provided with C tubes on one side of the keel and M-B tubes on the other. In smooth water and with no interfering shipping, the C tubes operated very satisfactorily. The selectivity of the M-B tube made it preferable in other cases. Original difficulties in mechanical design and troubles with leaks were finally overcome, and the tubes maintained in good condition during service.

The M-F Tubes.

In Figure 18, a line of receivers is illustrated with connecting tubes of such length that a sound proceeding

in the direction of the arrow is focused at the collection point. Such a line was called "forward compensated." The tube connections are similar to those of the M-B tube except that the air paths from the receivers to the collection points are not equal in length. Each junction point divides the length of the horizontal tube on which it lies in the ratio 65:35, the value of the ratio being easily found from the ratio of the velocities of sound in air and in water, and the condition that the line shall be "forward compensated." A single forward compensated line may be used as a detector, the line being mounted like the M-B tube, and the final output passing to the stethoscope ear pieces through a Y connection. Direction is then determined by maximum alone, without the aid of the binaural effect. Tubes of this type were installed on some of the chasers. They were even more free from water noise than the M-B tubes, but were not so accurate for directions.

The binaural effect may be secured, together with the advantages of the forward compensated line, by using a pair of such lines mounted parallel to each other at a horizontal distance of about three feet, the output of the two lines being led to the listener's ears separately. Such a device was called a "double M-F tube." Each line was held in an encasing pipe similar to that of the M-B tube, the two pipes being held by an X-shaped spider. Two of the arms of the spider were hollow and contained the acoustic tubes leading from the lines to the vertical column. Acoustically this was the most perfectly operating multiple unit device developed, though unwieldy for use aboard ship. Its focus was extremely sharp, its selectivity and range very great. Instruments of this type were used mostly for stationary listening stations, light ships for example.

It is obvious that increased selectivity may be obtained by increasing dimensions and number of receivers, but a limit is soon reached, when rapid manual manipulation is required. Compensated areas were also experimented with, and were exceedingly good receivers, but they were never developed for practical application.

The chasers were equipped with a C tube, an M-V tube, and a K tube. The K tube was a device developed by the General Electric Company for drifting patrol, and consisted of three microphones attached to a triangular frame, which was buoyed so as to lie horizontal under water. A cable led to the ship. Any pair of the microphones could be connected to two telephone receivers. The rotary compensator developed at New London, which



FIG. 18. THE M-F TUBE. This illustrates forward compensation. Each junction point divides the length of the horizontal tube in the ratio of 65:35, the ratio of the velocity of sound in air to that in water.

was described above, was adopted in a two unit form for use with the telephones. The direction was determined binaurally by the compensator. Being away from the listening ship the instrument was free from water noise, was very sensitive and had a long range when used in an area free of disturbances from other ships.

The chasers hunted in groups of three, the position of a submarine being determined by cross bearings from the directions obtained from the separate chasers, whose captains were in communication by wireless telephone. Their tactics were well planned, and "fixes" established with speed and accuracy.

The necessity of stopping to listen was, however, a drawback, and had the war continued, the chasers would undoubtedly have been equipped with M-V lines mounted in a specially constructed listening keel. An installation of this type was tested about the time of the armistice, and gave very good results. At about the same time a pair of very long lines of forty receivers each was tested in a listening keel built on a destroyer, with a special forty unit compensator. The device showed a very sharp focus, but it is doubtful if its acoustic advantage was sufficient to justify its complexity.

Electric M-V Lines. Listening Devices as Aids to Navigation.

Although it was not the intention to describe other than the multiple unit acoustic detectors in this place, a few words must be given to an outgrowth of these devices, the "electric M-V tube." The development of an electric M-V tube on principles corresponding to the straight acoustic M-V was undertaken at New London

by Professors G. W. Pierce and H. C. Hayes. Special microphones served as individual receivers. Their electrical outputs were compensated on the plan of progressive compensation of the acoustic M-V, the required time lags being introduced to proper amounts by the aid of a switch which passed the current from each receiver through an artificial line giving the required retardation. Compensation was not continuous but by small steps. A design was reached by Professor Pierce which gave the required retardation non-selectively for the frequencies in the range needed for listening. While in the straight acoustic M-V the compensator must be mounted near the outboard lines, in the electric M-V it may be put anywhere on the ship, which is a great convenience.

The interest in all these devices when developed was, of course, for the detection of submarines. It is clear that they furnish an aid of defense and offense against surface war ships as well, for use at night, and on days of low visibility. Even during the war their application as navigation aids was recognized, as is seen in the extract from the letter by Admiral Sims, quoted above. The devices are of use in avoiding collision in fog. In addition the position of a ship when making port can be determined in fog from submarine bells. Bearings of such bells, accurate to within two or three degrees can be taken from a ship steaming fifteen knots at distances up to forty miles, and by slowing down the range may be increased. It is hoped that in the future the devices may find wide application and receive further development. They should aid in minimizing delays in navigation, and in increasing safety at sea.

OUTFITTING A CONCRETE SHIP

By HARRY E. STOCK, WISCONSIN '06

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Outfitting a vessel means installing the joiner work and the equipment necessary to convert a bare hull into a complete ship, properly documented and ready officially to go into service. The work involved can be divided as follows:

1. Placing inserts and anchor bolts.
2. Joiner work.
3. Installation of main power plant.
4. Installation of auxiliary machinery and equipment.
5. Installation of miscellaneous machinery and equipment.
6. Installation of piping.
7. Testing machinery prior to acceptance of vessel.
8. Documentation.

1. The outfitting of a vessel actually begins with the placing of the first insert during hull construction. In order to take care of the passage of piping through the bulkheads and the fastening of the miscellaneous fittings to the concrete, it is necessary, as the construction of the hull proceeds, to imbed inserts of various types in

the concrete. These inserts range from ordinary anchor bolts to flanged pipe inserts and stuffing boxes. Most of the pipe inserts are of the flanged type so that the pipe lines can be bolted to them. In some cases the pipe line passes through the insert in which case it is known as a stuffing box type. The fastenings to the concrete, required for some of the miscellaneous fittings such as those for towing and mooring bitts, are very heavy. It can readily be appreciated that any deck fastening capable of withstanding the strain transmitted by the large hawsers used in towing and mooring a large vessel must necessarily be heavy. In the entire hull there are a total of about six thousand inserts and fastenings, and their proper installation requires the entire time of a crew of twelve men, whose duty it is to list, locate, install, and check them.

2. The joiner work of a vessel comprises the carpenter work not a part of the actual construction, and also the furnishings of the quarters. In the case of the 7,500-ton tankers, the contract for the joiner work in-

cluded the entire structure above the bridge deck, also partitions between the seamen's quarters on the main deck, and miscellaneous work, such as life boat chocks and the skylights. The officers' quarters are located on the bridge deck; the pilot house is on the deck above or the upper bridge deck; and the flying bridge deck is above that. The main joiner structure is long leaf yellow pine, tongued and grooved, the upper bridge deck and the flying bridge which are exposed to the weather being covered with canvas. In the officers' quarters the bunks are of oak. The furnishings consist of a small desk, a settee and a chair or two. The seamen's quarters are considered sleeping quarters only and are furnished with iron bunks.

3. The main power plant consists of three Foster oil burning water tube boilers and a triple expansion reciprocating engine. The boilers have a heating surface of 3,050 square feet, a normal working pressure of 225 pounds, and are equipped with Foster superheaters of 502 square feet capacity. The main engine, made by the Hoover-Owens Rentschler Co., will develop 2,800 horsepower at 88 r. p. m.

The fuel oil is supplied from four bunker oil tanks, two being forward of the boiler room and two aft of the engine room. The oil is heavy, and, in order that it may be pumped readily, it is first heated to about 90° F. by means of steam heating coils in the bottom of the bunkers. From the bunkers it is pumped through heaters, where the temperature is raised to about 230°F. and is passed into the burners of the boilers under a pressure of about 160 pounds. A mechanical atomizer at the burner tip sprays the oil into the combustion chamber of the boilers where it mixes with air in the proper proportion for the most efficient combustion. This adjustment is made by regulating the oil pressure and the supply of air.

Directly aft of the main engine is the thrust block containing the thrust shaft. The propeller drive shaft is coupled to this thrust shaft so that the engine is relieved entirely of any propeller reaction. This shaft is 13 $\frac{3}{8}$ in. in diameter and about 212 ft. long. The last section is known as the tail shaft, and it is this section to which the propeller is attached. The tail shaft passes through the stern tube which is provided with stuffing boxes which prevent water from entering the vessel around the tail shaft. The propeller diameter and mean pitch are both 16 ft. 9 in.

4. In addition to the above equipment there are the auxiliary machines, consisting of the main condenser, circulating pump, air pump (attached to main engine), feed pumps and injector, feed water heater, feed and filter tank, evaporator, fire and bilge pump, fresh water pump, sanitary pump, auxiliary condenser, and auxiliary combined air and circulating pump. There is also a distiller to replenish the supply of potable water for culinary purposes.

The main condenser is a surface type of 3,500 sq. ft. cooling surface and condenses the exhaust steam from the main engine. The water passing through the con-

denser tubes is pumped by the main circulating pump, a centrifugal pump with a 14 in. suction through the outboard skin of the vessel and an overboard discharge. The fire and bilge pumps are so connected that in case the main circulating pump is out of order, one fire and bilge pump can be cut in and used as a circulating pump. This reduces the vacuum but serves the purpose until the disabled pump can be repaired. Generally speaking, the auxiliary machines are in duplicate.

5. The cargo oil is handled by means of steam-jacketed oil pumps, two being installed in the forward pump room and two in the aft pump room. These pumps are each driven by a 90 h. p. steam turbine and will pump approximately 500 gallons a minute. All the cargo oil tanks are piped to these pumps, the oil being pumped to the main deck and then to the land connection.

The forward and aft cargo oil pump rooms are duplicates and are so piped that either pumping unit will discharge oil from any cargo oil tank in its end of the vessel.

One of the most important pieces of equipment on a vessel is the steering engine. This is screw-connected to the rudder cross-arm and is controlled from the pilot house by means of a telemotor hydraulically operated, the liquid used being glycerine.

The telemotor is erected on the foundation of the steering engine and is connected to the valves of the engine. It is connected to the wheel in the pilot house by means of two one-half inch copper pipes filled with glycerine. The turning of the pilot wheel controls the steering engine through the telemotor. The exact degree of throw of the rudder is indicated in the pilot house by means of electric bulbs on a dial. In case the steering engine is out of order it can be disconnected from the rudder cross-arm and a hand steering wheel can be thrown in. Should other methods fail, an emergency steering arrangement, operated by a capstan on the main deck, can be used. In addition to the wheel, telemotor control, and rudder indicator mentioned above, the pilot house equipment includes a compass, a mechanical telegraph, and three speaking tubes, one to the engine room, one to the steering engine room and one to the radio room. By means of the mechanical telegraph the pilot signals to the engineer in the engine room and gives him instructions in regard to the operation of the engines. The signals appear on the dials of the telegraph in the engine room and in the pilot house. Through the speaking tubes he can give verbal orders to the main engine room and to the steering engine room. He is thus able to control the ship through an engineer stationed at the steering engine should the telemotor control be out of order.

There are times when it is advisable to steer the vessel from the flying bridge deck and in order that this may be done the steering equipment of the pilot house is duplicated on this deck.

Forward and aft there is a dry cargo space, intended for light cargo. Two booms have been provided to

handle the cargo, one on the after side of the after mast and one on the forward side of the foremast. These booms are operated by means of winches installed on the main deck. On the forecastle deck there is the anchor chain windlass by means of which the anchors are dropped and hoisted in. There is no other machine on the entire vessel which must stand the wear and tear that this windlass must stand. When the anchors are dropped free and the heavy chain passes over the wildcats of the windlass at the rate of speed produced by the freely falling anchors weighing about 7,600 lbs. apiece, a great strain is put upon the windlass. On the forecastle and main deck there are also a great many fittings, principally bitts and chocks which are needed to moor a vessel to a dock. These fittings are solidly anchored to the concrete as they are subjected to heavy strains.

In loading or discharging a tanker the deck pipe lines are connected to the land pipe line by means of a flexible hose. This hose is handled by four twenty-five foot booms, two on the forward bridge bulkhead, one port and one starboard; and two on the after bridge bulkhead, one port and one starboard.

An important unit of the vessel is the refrigerating plant. This is the ammonia-brine circulating type, two-ton capacity, the brine passing through the piping in the meat and vegetable rooms. This system is capable of frosting the piping within about $1\frac{1}{2}$ hours after the plant is started in operation.

Electricity for power and lighting is furnished by two 15 k. w. 115 volt d. c. compound wound generators each driven by a reciprocating steam engine. Only one generator is operated at a time, the other being held in reserve.

The vessel contains a small machine shop equipped with a lathe (10 ft. long and 16 in. throw), a drill press, a double emery wheel stand, and miscellaneous tools. The tools are belt driven by a $7\frac{1}{2}$ h. p. electric motor.

The wireless equipment is what is known as the Navy type, with a 2 k. w. capacity and a transmitting radius of 1,800 miles.

6. There are a great many pipe lines on a tanker, chief of which are the following:

- a. Steam and exhaust.
- b. Cargo oil suction and discharge.
- c. Fuel oil.
- d. Fresh water.
- e. Circulating and fire lines.
- f. Sanitary system.
- g. Heating system in quarters.
- h. Heating system in cargo oil tanks.
- i. Steam smothering systems.

(a) The steam and exhaust lines are merely the piping common to any steam plant except, perhaps, for the piping to the auxiliary condenser and the combined air and circulating pumps.

(b) The cargo oil suction lines can be divided into two distinct systems,—forward and aft; the one forward is

served by the pumps of the forward pump room and the one aft by the aft pump room. Each system consists of two main lines passing through the center tanks, one on each side, with a line branching from these lines to the adjacent port and starboard wing tanks. These main suction lines are connected to both cargo oil pumps in their respective pump rooms so that oil can be pumped from any tank through either suction line by both pumps. The discharge lines run from the pumps to the discharge piping system on the main deck where land connections can be made.

(c) The fuel oil system can be divided into two systems, the fuel oil transfer lines and the fuel oil service lines.

The transfer lines make it possible to transfer the fuel oil from one fuel tank to another by means of transfer pumps. These have an overboard discharge also, so that an accumulation of water or dirty oil can be pumped overboard quickly. The fuel oil service systems are the lines through which the fuel oil is pumped from the forward fuel oil tanks (which are used as settling tanks) to the boilers. This system also has an overboard discharge so that any water or dirty oil can be pumped overboard.

(d) The fresh water lines handle drinking water only. The drinking water is stored in what are known as culinary tanks. There are two of them of 5,000 gal. capacity each installed on the starboard side of vessels in the engine room. The water is pumped from these tanks to a gravity tank on the upper bridge deck from which it flows by gravity through one line to a scuttle butt, where it is cooled, and through another line to the galley boiler and to the officers' quarters. In order to eliminate the possibility of a shortage of potable fresh water a distiller is provided which is connected to the culinary tanks and replenishes the fresh water supply from salt water distillation.

(e) The circulating system serves the main and auxiliary condensers, being supplied respectively by the main circulating pump and the auxiliary circulating pump, which have direct outboard or sea suction. The main condenser circulating pump has an auxiliary suction line from the engine room bilge so that in case of damage to the hull in the engine room this pump, by the opening of a valve, could pump water from the engine room bilge. The fire and bilge lines take care of any water or oil which may collect in the bilge of the vessel. These pumps are in duplicate, and have a sea suction so that in case of a fire sea water could be pumped. One of these pumps is also connected to the main condenser so that it may be used as a circulating pump in case of emergency.

(f) The sanitary system furnishes water to the toilets, bathrooms, engine and propeller shaft bearings, and the galley.

(g) All the seamen's and officers' quarters are steam heated. This system is apart from the other steam lines.

(h) In each cargo oil tank and fuel oil tank there are a number of heating coils placed about 18 in. above

the bottom of the tank. They are used to heat the oil so that it may be pumped more readily. The coils drain back to an inspection tank in the engine room where any oil which may find its way into the system through leaky joints or bursted seams can be detected. This is to prevent any oil from getting into the boiler tubes. Fresh water must be conserved on a vessel and clean steam condensation is used again in the boilers.

(i) Fire hazard in a tanker is great, and to reduce it to a minimum each cargo oil and fuel oil tank is provided with a steam smothering line, which serves as a fire extinguisher. The paint storage room and two dry cargo holds are also provided with steam smothering lines.

7. When the steam plant and auxiliary machinery are completely installed, a dock trial is held during which all the machinery is tested. The vessel is securely moored to the dock and the main engines are operated for six hours continuously. All the auxiliary machinery and the refrigerating plant are operated a sufficient length of time to reveal any defects, either in installation or in the machines themselves. When all defects have been corrected, and the vessel is complete, a trial trip is held at sea. In the case of an oil tanker this trip consists of a twelve-hour loaded continuous run, in addition to the testing of all equipment including the deck machinery. After a successful trial trip the vessel is brought back to the dock, given a final tuning up, and turned over to the managers, who assign a crew.

8. A vessel is not ready to go to sea until it is properly documented. The documents required are as follows: Master carpenter's certificate issued by the hull builder; assignment of official number; certificate of admeasurement; Panama and Suez Canal certificates; and certificate of registry, all issued by the U. S. Custom House; certificate of freeboard, anchor and chain certificates, certificate of classification and certificate of classification of machinery, certificate of seaworthiness, all issued by the classification societies—Lloyd's Register of Shipping, or the American Bureau of Shipping; steamboat inspector's certificate issued by the U. S. Steamboat Inspection Service; various receipts, for nautical instruments, equipment, and stores put aboard, issued by whatever officer receives them for the vessel. When the above certificates have been issued and duly filed it can be said that the vessel is officially ready for service and can be lawfully operated.

SAINT PATRICK'S PARADE

By CHAUNCEY M. MORLEY

Senior Electrical

The progeny of the puissant Pat are to be pardoned a feeling of complacent pride in the parade, which was held March 19. The fact that it was a success is attested to by the fact that the Skyrockets Editor of the Cardinal had no criticism to make. And in a case of this kind, silence from the Skyrockets column may well be considered the height of praise.

At two-thirty, the line swung down State St. between

two lines of interested, and supposedly appreciative spectators. Leading were the street cleaners, busy with cart and broom, solicitous and conscientious in the discharge of their duties. Then came the band, synchronizing the feet of those afoot with spirited strains. Fol-



"PETE" SCHUYLER AND FRANK SCHMIDT. *Burlesquing the Prom.*

lowing was the snake, thirty feet of him, green and vicious looking, carried with ice tongs by several fearless youths whose serpentine progress, with its swings almost into the crowd, brought screams from the timid spectators.

And after the snake, drawn in a barouche by several of his myrmidons, a supercilious coachman seated on the driver's seat, was St. Pat. A noble and commanding figure he made, with his Titian tresses floating from under his derby, which was tastefully trimmed with a green ribbon, and his benevolent whiskers forming an aureole about his Hibernian countenance. He acknowledged the plaudits which greeted his passage with bows and smiles, which blended the proper proportion of dignity and condescension.

The Blarney Stone, covered with mysterious hieroglyphics, had been removed from its place in the secret vault under the Engineering building, and was borne along by four muscular engineers. A suitable escort for the stone, necessary because of its immense value, and the fact that it would be impossible to replace it, was furnished by the military department, who followed with a field piece.

The course of the original eight o'clock, an immense time piece that had once done duty in front of some jeweler's establishment, was followed by hisses and groans.

The next float depicted a group of lawyers in the act of taking their bar exam, and was reminiscent of the good old days of the Silver Dollar and similar filling stations. Several law students in the crowd, seeing this

familiar scene, so common in other and happier times, burst into tears, and had to be taken home.

The Gun and Blade club furnished a squad, commanded by an officer whose insignia showed him to rank variously as a lieutenant, captain, major, and colonel, and who wore enough medals to sink a canoe. Their military bearing was such that Tommy Atkins, after one look, turned around and bit a lamp post in two. They escorted a hangdog German prisoner.

The next float extolled the virtues of the Home Ec course in a very graphic manner. The Home Ec graduate proved herself to be a wizard with the wash board, as the numerous articles of wearing apparel of a rather intimate nature which she continuously hung on the clothesline testified. Her husband, a man of large leisure, sat at ease, his perusal of the paper interrupted only when his wife flourished a suggestive rolling pin in his direction. Following this was an exhibit which was not such a recommendation for the course, but still



ERNIE LONGENECKER AND HIS THOROUGHbred. A slam at the Little International Live Stock Show of the Ag school.

wrung a sigh from the breasts of the most hardened. It was a hearse, inside of which could be seen the casket of an unfortunate Home Ec who, so a sign informed the reader, was so ill-advised as to eat her own cooking.

The laws of chance were demonstrated by a blackamoor who acted as chauffeur to a duo of dashing dominoes.

Three substantial Phy Eds. conveyed by a truck, gave exhibitions of their strength and skill. On the side of the vehicle an enthusiastic recommendation, addressed to Miss Trilling, told of the success of a former pupil who, after completing the course, was able easily to support her husband.

The couple following was attired in the height of fashion, the man in a Prince Albert, and the lady in hoop skirts. By means of an ingenious system of pulleys and ropes, the lady's skirts were made to rise at frequent intervals, which caused her no little embarrassment.

The prom goers suggested a possibility hitherto overlooked, which may be of interest to economical gentlemen to whom the price of transportation to and from the capitol is a drawback. This couple rode serenely on a motor cycle. The manager of the Yellow Taxi system regarded this as being an action in restraint of trade, and spoke darkly of injunctions.

A portion of the Little International was presented in a spirited manner by a cow-boy who bestrode a fiery saw horse, mounted on a small truck. A sight of the animal would no doubt have caused Mr. Burroughs to renew his cry of "Nature faker," as it sported a paint brush for a tail, and the lively movements of its head were caused by a well placed spring.

The commerce goat, a docile animal, was led by several triumphant engineers, a sign announcing that they had obtained the animal a short time previously.

The Physics department float was of great economic importance, the designers alleging that they had discovered a way of eliminating the middleman. Their machine, mounted on a truck, manufactured a staple article, taboo but greatly in demand, which, through this invention, passes directly from maker to consumer.

The future of the commerce student was forecast in the next exhibit, which consisted of two junk wagons, piloted by meek looking gentlemen with large ears, parabolic noses, and derby hats, much too large.

"The Engineer As He Is," showed him at work, madly operating his slip stick, and searching frantically through math books. On the rear end of the float he was shown as he ought to be, sitting snugly on a comfortable davenport with a beautiful co-ed, with thoughts of Kahlenberg, Stichter, and Snow far from his mind.

The methods of the Medics were unmasked in the next float. Poor cripples, who dropped in the street, were gathered up by the indefatigable stretcher bearers and hurried to the doctor. He, assisted by his nurse, administered an anesthetic by a few well-directed blows of a hammer, and took a hasty X-ray picture, to determine the nature of the disability. In all case the men were operated on, the tools being a saw, bit, and screw-driver. In each case recovery was miraculously sudden; the invalid soon recovered sufficiently to pass into the drug store on the rear end of the truck and get his prescription filled, after which he was discharged as cured.

An enterprising group of surveyors, equipped with all necessary apparatus, surveyed the length of numerous skirts along the line of march. The data collected will be turned over to Dean Nardin. At the same time, another group devoted all of their energies to calibrating moustaches, the results being needed in order to compute the age of St. Pat.

A pitiful sight next met the eye: Two blind students, feeling their way along with canes. Signs which they carried notified beholders that they received their affliction from the sore eye special.

The Ag and Home Ec school's were typified by a man in the costume of a farmer, and a woman dressed as a kitchen drudge. A rope stretched between them represented the Extension Division.

The hard lot of the music student was set forth in the next float. The students reclined in voluptuous ease about a victrola, whose music the director led with graceful gestures of his baton. With his free hand he distributed credits by the hundreds.

The gigantic slip sticks, used in all engineering projects of moment, were in line, and were followed by the "Engineer at Work." The man who devised this float was obviously an efficiency expert, and has devoted years of effort to the discovery of some device whereby the time consumed in going to and from classes would not be lost to study. A drawing board, mounted on a roller skate, provided a portable work table, and a means of utilizing time hitherto wasted.

Finally came the Ags, with their home grown auto. This car is the result of years of research, and possession of the plans will make it possible for anyone who has a gas engine, a threshing machine, and a few hairpins to make a trustworthy and speedy car.

The number and excellence of the entries does credit to the men who constructed them, and to the committee who directed and organized the parade.

LICENSING WISCONSIN ENGINEERS

By A. ROLLIN STRIEGL

Senior Civil

Do the engineers practicing in Wisconsin want an engineers' licensing law? If so, they should be out educating the public and their brother engineers to the need for such a law instead of "watchfully waiting" to see what will happen. It is very improbable that a law requiring the examination and registration of professional engineers will be passed by the present legislature, because the engineers of the state have not yet fully awakened to the desirability of such legislation. "Two years from now the state without a license law will be in the 'backward' class and the engineers of that state will have but themselves to blame for their predicament." (Professional Engineer, Nov. 1920). Present indications point to progressive Wisconsin being in the "backward" class unless our engineers show more enthusiasm.

Why an engineers' licensing law? There can be only one answer which the legislature will accept as a sound reason for enacting such a statute. The overwhelming answer must come from the public as well as from the engineers: "To promote the general welfare."

Will state licensing of engineers protect the interests of the public? There are those who argue that examinations do not give proof of integrity and reliability but merely reveal a certain amount of technical knowledge; that incompetent men will still be able to continue in

practice; and that under any workable scheme of licensing, a man who secured his certificate of registration as a civil engineer, for example, would still be able to practice other branches of the profession for which he was not qualified by education or experience. Of the first we would ask whether they realize that under our present laws it is entirely possible for one to be a lawyer, doctor, butcher, or baker today, and an engineer tomorrow "for no reason other than he so wills it, with no previous experience, without control, and without regard to the interests of the public," (O. W. Rosenthal, Engr. and Contr., Dec. 22, 1920). While it is quite probable that all licensed engineers will not be of the highest character, it is reasonably certain that a man who must have had some experience and who has an interest in guarding his honor and his title of Professional Engineer will also have more interest in giving the public honest service than the man who has hung out a newly painted shingle, accumulated a few handbooks and blueprints, and made himself a practicing engineer overnight.

Doubtless some incompetent men will always be able to practice engineering. In the transition from the present condition of allowing anyone to practice as an engineer who so wishes, to the desirable condition of allowing practice as a professional engineer only after examination, many men must be granted licenses who would be unable to pass an adequate examination. This is true because the statutes provide that no man shall be deprived by law of his means of earning a livelihood. Elimination of the incompetent practitioner would therefore not result immediately on the passage of a licensing law but would be possible of achievement in the future as a result of the provisions of such a law. Requiring all engineers to take an examination based on their technical knowledge and experience before engaging in professional practice would almost certainly deter the grossly incompetent from attempting to pose as engineers, or would weed them out if they should so attempt, and after the short transitional period the public could call in and advise with a registered engineer without fear of engaging a man better qualified to call himself a plumber.

It is not feasible to examine an engineer in every branch of the profession in which he may have occasion to engage. This is true because of the difficulty in defining what constitutes engineering, civil, electrical, mechanical, or whatever the branch may be, and because of the overlapping nature of all engineering work. Every engineering construction of any magnitude involves the practice of several specialties. For instance, if an engineer were allowed to have responsible charge of only one class of engineering work, the construction of a hydro-electric plant would require the services of three engineers and possibly an architect: a civil engineer to supervise construction of the dam and foundations, a mechanical engineer to care for the machinery end, an electrical engineer to design the transmission system, and an architect to advise on construction of the power house. Such a condition is obviously impracticable be-

cause the men employed might fail properly to co-ordinate their plans, and a lack of complete harmony would defeat the very end which the regulatory law was designed to accomplish. The only practicable solution of the difficulty is to require the examination of an engineer only in the specialty which he practices most, but to allow him to supervise work in all branches of engineering. This necessity for leaving a man free to practice on work for which he has not been examined is no argument against registration. A registered engineer may have his license revoked for fraud or incompetency in any line of engineering work and hence will carefully guard against undertaking work for which he is not qualified, not merely to keep his license, but to protect his reputation as well.

Opponents of registration for engineers are careful to point out that "Protection for the public can be secured not only by a state license to the properly examined and qualified practitioner, but it can also be secured by the requirement for approval of plans and by inspection by duly qualified state officials. For example, the approval of plans and construction for dams is required by state boards in Connecticut, New York, and Pennsylvania. Almost all states require approval of plans for sewage disposal by the state board of health, and many states make the same requirement for water supply. State and municipal building codes furnish an example. Massachusetts requires state approval of plans for railway bridges, and other state utility commissions through their engineering staff supervise engineering construction to a greater or less degree. State supervision as just outlined is the more obvious procedure to the public." (L. K. Sherman, *Engr. and Contr.*, Apr. 2, 1919). Why, then, should engineers bother about a licensing law when the public can be protected by such a simple procedure? Chiefly because the public cannot be protected adequately in that way. The most flagrant violations of good engineering usually occur in the smaller works for which an engineer is called in to advise with private individuals and small companies. To furnish protection in such cases by state approval and inspection of the work would require an unwieldy and expensive organization. The enforcement by commissions of various codes of construction practice must of necessity be perfunctory and left largely to the honor of the engineer. The most that the commission can do is to halt work below certain standards; they can by no means compel the doing of the best class of work that is known to engineers. Another reason why extension of state inspection is not advisable is that all utility commissions, and consequently their engineering assistants, are more or less influenced in their work by the necessity for keeping in favor with the political boss. It may be argued that an engineering examining board would be subject to the same influence, but, serving as they should practically without pay and being appointed for a long term of years, the members would have little reason for fearing political disfavor.

Many engineers, when asked why a registration law should be passed, stated that regulation of practice would

act to increase the pay of professional engineers. Improvement in the general standing of the profession, and avoidance of competition with the disreputable engineer who has nothing to lose and so can afford to accept employment at a low salary with the expectation of doing an inferior class of work, will doubtless tend to increase the compensation of professional engineers. Once the public has a well-founded confidence in the engineering profession and realizes that real engineering service is the result of years of study and experience and cannot be given by any man who has incidentally learned to use a level, the engineer will, in all probability, receive a fair return for his work. The benefit of a licensing law in this field should not be overlooked by the engineers themselves, but should be advanced with the greatest caution in discussing the matter of registration with the public, because men are naturally suspicious of any regulation which will benefit a group financially.

Perhaps the most important reason why Wisconsin engineers should bestir themselves to have a licensing law placed on the statute books is that such laws are now "the fashion," so to speak. Eleven of the united states now have laws requiring the licensing of engineers. In some sixteen other states licensing laws are being actively supported by the engineering societies, many of which laws will undoubtedly be enacted during the present year. Six provinces in Canada have enacted licensing laws and the other two main provinces contemplate such action in the near future. Mexico has long had a regulatory law. The desirability of licensing has been recognized in principle by the Institute of Civil Engineers in England and that country will probably require registration of engineers in the not distant future. Other leading countries also have governmental regulation of the practice of engineering. "The time has come for engineers to act together in self protection and to promote uniformity of regulations." (*Mining and Scientific Press*, Feb. 1, 1920). "It seems to make very little difference whether individual engineers are in favor of such legislation or not, because of the fact that eleven states already have enacted such laws, and it is now important that the engineering profession unite in demanding uniformity of legislation and the elimination of unnecessarily burdensome requirements." (T. L. Condon, *Engr. News-Record*, July 1, 1920). Most of the states having licensing laws are co-operating in a movement to enact suitable reciprocity clauses so that a licensed engineer can practice in all states requiring licensing without being examined in each. Similar reciprocal relations will undoubtedly be worked out between the various countries. But an engineer from a state not requiring licensing must either go out of his state to get a license or be subject to the embarrassment and annoyance attendant on the necessity for taking an examination in each state in which he may wish to practice. Would it not be far better to be licensed in the home state and then to be in a position to take advantage of reciprocity agreements?

(Continued on page 128.)

“—but the wire has no hole for electricity to flow through”

IT was a lawyer talking, and when he made this brilliant observation an engineer present couldn't help chuckling.

How absurd, he thought, that anybody could be so ignorant of the properties of current electricity.

But by the way, oh stern critic, what are mechanics' liens and what are the mutual obligations of partners? When the talk turns to law or business or the seven arts, have you opinions to express and can you express them without the fear of making a “break”?

Looked at in this light there seems to be some sense to the argument for a broad curriculum for engineers.

Though your object should be first and foremost to find out more than anybody else knows about some specialized phase of engineering, don't miss any chance to get acquainted with every common interest which may influence the social and industrial life of the day.

This is nothing but a matter of good business. It will enable you to meet men on their own ground.

And because life is too full to learn everything about everything, this habit teaches the greatest lesson of all—the necessity of getting at fundamentals and applying basic principles already learned to each new problem.

It is this attitude of mind which will earn you a place in the inner office where they discuss, not details, you may be sure, but policies.

* * *

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(Continued from page 126.)

Self protection is the duty of every man. Engineers should be awake to encroachments on their field of work. "The American Institute of Architects has proposed a model law that is so restrictive of other branches that unless engineers become sufficiently interested to investigate the matter thoroughly and make their combined opinion felt, they are likely in the near future to find their activities curtailed to an awkward degree. Under the model law proposed by the American Institute of Architects it would be unlawful for any but an architect to design or supervise the erection of a bridge, or any structure consisting simply of foundations and girders." (Mining and Scientific Press, Feb. 14, 1920). Such restrictive and selfish measures are of course self condemnatory when their true nature is exposed, but, never-the-less, they point out that the engineer should appreciate the problem at hand and should realize the necessity for action.

Due to the collective effort of a group of interested men who during the past two years have been studying the matter of licensing engineers, a law which is believed suitable to meet Wisconsin conditions has been drawn up and is now before the Wisconsin Legislature. Every engineer in the state should know the substance of that bill, as its passage or non-passage may vitally affect his future career. Lack of co-operation and enthusiasm among the engineers of the State in preparing the bill for presentation, and in backing it before the legislative committee now that it has been presented, will very likely (almost inevitably) mean its defeat at this session of the Legislature. If Wisconsin engineers want a licensing law *now* is the time to let that fact be known. Remember, two years from now the state which does not license engineers will be among the 'backward.' Unlicensed engineers will be handicapped in competition with licensed members of the profession. Let's make our stand on licensing known and, further, "Let's do it now."

FINANCIAL REPORT OF THE ENGINEERS' MINSTRELS

Receipts.

Proceeds from Engineers' Dance—\$	6.73	
Net Tickets Sales, Nov. 12-13 --	2,515.60	\$2,522.33

Disbursements.

Production Expense -----	450.00	
Advertising and Publicity -----	335.23	
To the 1920 Homecoming -----	150.00	
Costume -----	348.65	
Staging and Music -----	509.10	
Administrative Expense -----	287.64	
Incidentals -----	29.36	
The 1922 Badger—2 pages -----	40.00	2,149.98
Net Balance—to be given to the Union Memorial Fund -----		\$372.35

THE CHEMICAL ENGINEERS' SOCIETY

At the weekly meeting of the Society March 22, L. F. Buckingham explained the manufacture of salt, and illustrated his remarks with diagrams showing the structure and operation of the Manistee salt condenser. A. J. Huegel described different methods and processes of tanning leather.

The annual banquet of the Chemical Engineers' Society at the University Club was a great success, and shows that the Society is enjoying one of the most successful years since its inception in 1915. Election of officers was held at the banquet. Those elected are: President, C. M. Kurtz; vice-president, E. Buttermann; secretary, J. P. Gerhauser; treasurer, A. C. Vobach.

THE A. I. E. E.

At the meeting of February 27, D. J. Stewart and M. P. Hanson were elected Branch representatives in Polygon.

The program for the meeting of March 30 consisted of a paper by H. G. Lindner describing various types of circuit breakers, including the high speed types which have recently been developed. A short business meeting followed the regular program.

The Bureau of Mines has recently undertaken to determine the best method of supplying fresh air for the projected Hudson River Vehicular Tunnel which the New York and New Jersey State Bridge and Tunnel Commissioners have under construction. The research work of the project is to be carried on in the experimental mine of the Bureau of Mines which is located at Bruceton, Pa., just outside of Pittsburgh. An oval-shaped tunnel, similar to the one to be constructed under the Hudson River, is being built underground, large enough to accommodate a single line of automobiles with the usual space. Study is to be made of various effects of vehicular traffic, such as the diffusion of exhaust gases, temperature conditions, and physiological effects of temperature, gases, and smoke under ordinary operating conditions.

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EDITORIALS

THE EXPOSITION

After an interval of six years, the university exposition is here again. It is a big show and represents a lot of hard work, both mental and physical. It is rather an oppressive task for the student committee that has handled it and, with its demands for laboratory equipment, it inconveniences routine instruction. There is no denying, however, that it is a most enlightening exhibition. Even faculty members who have been on the campus since Hector was a small pup will discover that, in a university the size of Wisconsin, advancement goes on at a pace that defies the efforts of any one person to keep posted. There is much to be learned at the exposition in regard to the multifarious activities of the University. It should be a source of inspiration to the sons and daughters of Wisconsin, now in residence; it will furnish substantial conversation about the university for days to come,—something just as thrilling as the “Tootsie’s Ptomaine” type of university chatter, and a good deal more helpful to all concerned.

MISTAKEN WIT

Almost every campus publication has a corner devoted to the lighter side of life,—its humorous column. Men and women in every walk of life enjoy a bit of amusement and reading where deep thinking is not required. True humor is enlivening, but when it degenerates into the type of jokes which have recently found space in certain campus publications, it is a sad commentary on the condition of mind of the writer. When campus wits can think of nothing more humorous than a play on words of two meanings,—which one must morally distort and then call humor,—or a capitalization of women’s legs, they might better refrain from writing. Such trash is not humor, it is a reflection on Wisconsin. If only we of Wisconsin read our magazines, we might make allowances for our humorists. But Wisconsin magazines are found in reading rooms of many colleges and libraries, and Wisconsin, to many, is what is on the printed page before them. Truly it is to be hoped that Wisconsin has not been judged by some trash which has been labeled humor and put in print recently.

THE BALANCED SCHEDULE

There are three fields among which students may profitably divide their attention: Scholastics, athletics and such activities as the press, dramatics, and forensics. Scholastics, of course, are primary and should demand the majority of time and thought, but to derive the fullness of a college education the student must develop his personality and physique. This latter development is best sought in the field of activities and athletics.

The recent cases of athletic ineligibility due to ‘cons’

and ‘flunks’ in engineering subjects evidence the fact that some engineers have failed to strike a balance between their scholastic and athletic activities. Other cases, quite similar, show scholastic failure resulting in expulsion from the university due to an over-emphasis on activities and an under-emphasis on class-room work.

It is possible for every engineer to enjoy the benefits of this broad college life without suffering the consequences of scholastic failure, by a simple apportionment of time. Draw up a schedule; determine the hours which can be spared from study; strike a balance between scholastics, athletics, and activities. This balancing requires accounting effort, but upon it depends collegiate success.

VACATION EMPLOYMENT OFFERS MATERIAL FOR TECHNICAL ARTICLES

Almost every student of engineering has been engaged in some form of practical work, either during vacations or at some time previous to entering the University. Published accounts of such work would often be of interest and value to other engineering students, and the time taken to put such material in writing is time well spent. The engineering student who has information not commonly known, the knowledge of which would benefit his fellows, owes it to them to publish it. It is hoped that among the material collected or surveyed for the *ENGINEER* for the coming year, there will be many student articles of this type.

THOSE UNRELIABLE AMERICAN DYES

There seems to exist throughout the United States a belief that the only fast dyes are those of German manufacture. Whenever a cloth article fades, the common consolation offered is the old excuse that “good dyes are hard to get”, or that “American dyes are unreliable anyway.” Blame is placed, on the ignorance of the chemist and his inability to synthesize good dyes. Nothing can be further from the truth. American coal tar dyes are chemically identical with those of German manufacture, and, if properly used on the materials for which they were intended, give results equal to those of foreign manufacture. The German dyes were never guaranteed. The chief source of trouble with dyed material is a result of the dyer’s capitalization of American ignorance and belief in German dyes. In almost every instance of “those unreliable American dyes” which has been investigated, trouble was due to the improper use of a good dye or the substitution of inferior color for good, fast dye. As a result, American dyes and American chemists were blamed instead of certain smooth, American manufacturers, who remained publicly blameless and pocketed a substantial increase in price due to the “scarcity of good dyes.”

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Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

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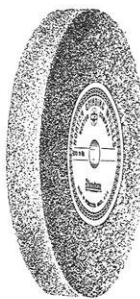
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ENGINEERING REVIEW

By M. A. HIRSHBERG

Ultra-Precision

Says Power Plant Engineering (Chicago):

"We have for some time past grown accustomed to the common limit of precision in machine work, i. e., the thousandth of an inch. Most of us, no doubt, have also heard in a general way of the high precision afforded by the so-called interferometer methods developed for use in connection with the manufacture of gages. The latter method has given us precision measurements accurate to one-millionth part of an inch. The new ultra-micrometer developed by Professor Whiddington of Leeds University, England, now permits measurement to the scarcely credible precision of one two-hundredth of a millionth of an inch! The new apparatus is based on the fact that if an electric circuit consisting of a parallel-plate condenser and inductance be maintained in oscillation by a thermionic valve, a small change in distance between the plates of the condenser produces a change in the frequency of the oscillations which can be accurately determined. So sensitive is this device that the bending of a very substantial table due to the weight of an English penny may be clearly indicated."

The World's Highest Dam

In Boulder Canyon, in the southeastern tip of Nevada, Uncle Sam has just completed the preliminary work for a dam 300 feet wide and 700 feet high,—approximately the height of the Woolworth building. It will turn the Colorado River at this point into a lake as large as Lake Superior. It will satisfy a long felt need of the Southwest for irrigation. Enabling legislation will be asked of the next Congress. It is estimated that it will take 25,000 men five years to complete it.

Crewless Automatic Trains

The New York-New Jersey Port and Harbor Development Commission has recently published its report, in which are recommendations for expenditures of \$400,000,000 for a system of belt railways, tunnels, and transfer yards to facilitate the handling of freight through the port. An interesting feature of the project is the proposed operation of crewless automatic trains, for handling food and all other local traffic from transfer yards on the Jersey side, through tunnels and subways to Manhattan terminal warehouses.

Australian Steam-Electric Plant to Use 50-Cent Coal

Construction was to have been started April 1 on a 125,000,000 kw. steam-electric plant, 112 miles from Melbourne, Australia, according to announcement from Australian government offices. This is a governmental undertaking, to be carried out by the Victoria Electricity Commission, which proposes to develop extensive coal

deposits at the plant sites, use the coal for generating electrical energy and transmit the power electrically to Melbourne and other industrial centers. Included in the project for which immediate construction is planned are a total of 1800 miles of high-tension transmission line and three terminal substations. The trunk line voltage will be 132,000. The coal deposits are said to be very extensive, and the report states that the coal can be delivered to the power house for about 50 cents per ton. Condensing water is supplied by a river alongside the power house.

Steam-Turbine Locomotive

According to the *Railway Gazette* of London a turbine driven locomotive is now being tried on the Swiss Federal Railways. The engine is designed for a turbine speed of 8000 R. P. M., giving a running speed of 49 miles an hour. The boiler is equipped with a superheater and condenser, fitted below it, which utilizes water from the tender. Cooling is effected by allowing the returning water to fall in narrow streams from the roof, extending over the tender, designed for the purpose. As there is no blast nozzle, an air draft through ventilators is used in conjunction with a blower for maintaining the required action on the fire. It is claimed that while making trial trips the engine has shown a fuel economy which betters that of the compound locomotives in service by 25 per cent, while it runs very smoothly at high speed, this being accounted for by the reduction in the number of reciprocating parts.

Research Information Bureau

A Research Information Service has been established by the National Research Council as a general clearing house and bureau of information for scientific and industrial research. Information is supplied upon request concerning research problems, progress, laboratories, equipment, methods, publications, personnel, funds, and similar matters. Except where unusual difficulty in obtaining the desired information makes it impossible, inquiries will be answered without charge. Requests should be addressed to Research Information Service, 1701 Massachusetts Avenue, Washington, D. C.

Peat as Railroad Fuel

The Railroad Board of Sweden, after long continued tests on powdered and briquetted peat for locomotive fuel, has recently taken over a large plant near a bog in the vicinity of Vislanda where fuel for this purpose will be manufactured. The peat is dried in the open air, and then by machinery, is cheaply converted into an effective briquetted fuel.

ALUMNI NOTES

By DAVID W. McLENEGAN

E. L. ANDREWS, e '16, who has been employed in the Publicity department of the Cincinnati office of the Westinghouse Co., has returned to East Pittsburg, and is in charge of the merchandising section of the publicity department.

C. M. BARBICUR, m '14, is assistant engineer in the Electrical Engineer's office of the Southern Pacific Company, San Francisco, Cal. He is working towards an M. E. degree, which he expects to acquire this June.

BEN S. BUCKMASTER, m '16, is with the James A. Brady Foundry Co. of Chicago, Ill.

F. T. COUP, e '12, is in charge of the Milwaukee sales office of the Wagner Electric Company.

A. E. CUMMINGS, ex-c '15, has completed the requirements of the civil engineering course and will receive his bachelor's degree this year. He is connected with the Raymond Concrete Pile Co., 111 W. Monroe St., Chicago. He was married four years ago to a Wisconsin girl of the class of '15.

RALPH W. ENGBERG, '14, was married recently. He is engaged in equipment engineering for the Automatic Electric Co., of Chicago.

REIMAR A. FRANK, m '20, is employed in the sales department of the Lyon Metallic Mfg. Co., Aurora, Ill.

ARTHUR W. GAUBATZ, m '20, has left the Elwood Tractor Company of Madison and taken a position with the DuPort Motor Company of Superior. RALPH T. OSMAN, m '20, is with the same company.

ERNEST VON GELTCH, e '11, who has been suffering from tuberculosis for over seven years, is recovering rapidly. He is at Tomahawk Lake, Wisconsin.

JAKE GLAETTLI, c '09, who has been at San Diego, building concrete ships, has returned to Milwaukee, and states that, for the present, his address will be 158 Reservoir St., Milwaukee.

PAT MAC GILVARY, e '16, is back in Boston, after spending six weeks in a lumber camp recuperating from the cares of business. He is with the Tel-U-Where Company.

ADOLPH F. MEYER, c '05, C. E. '09, is a consulting engineer, residing at 1467 Ashland Ave., St. Paul, Minn.

E. B. MORSE, e '18, and wife visited Madison the week end after Easter. Mr. Morse is at Appleton, Wis., with the Valley Iron Works Company, manufacturers of paper mill machinery.

ALLEN E. NANCE, c '15, is in the metallurgical department of Dodge Bros., at Detroit. His residence is 278 E. Canfield Ave., Detroit.

R. C. NEWBERRY, e '12, is located at present in Denver with the Denver Gas and Electric Light Co., in the interest of the H. L. Dougherty Co.

ARTHUR C. NIELSEN, e '18, is an efficiency engineer with the H. P. Gould Company, Chicago. His home address is 3441 Home Ave., Berwyn, Ill.

J. P. PEDERSON, m '17, is a production engineer with the Pierce Arrow Motor Company, Buffalo, N. Y. His address is 723 Delaware Ave., Buffalo.

A. O. POWELL, c '80, C. E. '90, and Joseph Jacobs, A. S. C. E., have formed the firm of Powell and Jacobs, Consulting Civil Engineers, with offices at 613-616 Thompson Bldg. Seattle, Wash. The firm will specialize in irrigation, drainage, water power development, and valuation work, etc.

WALTER A. ROGERS, c '88, of the Bates and Rogers Construction Co., of Chicago, addressed the annual meeting of the American Road Builders' Assn., Chicago, February 12, on the subject of highway transportation. His address is

printed in the March number of The Bulletin, published by the Associated General Contractors.

WILLIAM A. ROWE, e '04, is an engineer and contractor in Eau Claire, Wis. His address is 818 South Barstow St.

WALTER B. SCHULTE, ch '10, Ch. E. '11, who is connected with the Burgess Battery Company, has been awarded patents on a new dry cell and on a two-solution pasting process.

JOSEPH SCHWADA, c '11, formerly structural engineer in the Wisconsin State engineering department, has been appointed structural engineer in charge of the planning and construction of the new Riverside pumping station of the Milwaukee water department.

HARRY A. SEVERSON, c '01, gives his address as 1402 Harlem Blvd., Rockford, Ill. He is a manufacturer of machinery and tools.

E. K. SMITH, c '14, assistant city engineer of Beloit, attended the meeting of the Wisconsin Society of Engineers here last month.

ALLEN SPAFFORD, ch '20, was married to Miss Virginia Gallentine of Kearney, Nebraska, on February 12. They will live in Appleton, where Mr. Spafford has a position with the Kimberly-Clark Paper Company.

JOHN TANGHE, c '16, is the father of a baby girl, born early in February.

A. L. TEODORO, c-ex '21, is at Cornell University. He has recently had his scholarship from the University of the Philippines extended to 1922, and will take up graduate work in leading toward a Ph. D. in rural engineering.

Announcements have been received of the marriage of HOWARD THWAITES, c '16. He is employed as estimator by the Plankinton Packing Co., Milwaukee.

JACOB TRANTIN, JR., ch '15, is with L. V. Estes, Inc., Chicago, Ill., in the capacity of industrial engineer.

HERMAN H. VEERHUSEN, C. E. '12, is president of the Lithoprint Company of New York, Inc. His home address is 1306 Ocean Ave., Brooklyn, N. Y.

L. E. VOYER, e '11, is an illuminating engineer for the General Electric Co., Rialto Bldg., San Francisco, Cal.

R. L. WADSWORTH, m '17, is assistant superintendent of the Wadsworth Watch Case Co., Dayton, Ky. "Ducky" was well known around the campus as a stage star and Badger Editor. He was captain of artillery in the war. His home is at Ft. Thomas, Ky.

"PETE" WALRAVEN, who finished his course in Civil Engineering last February, is now with the Greiling Construction Company as assistant engineer on a bridge job at Kenosha. Pete says the work agrees with him. He is working with RAY HEFFERNAN, c '20, who has been with the same company since his graduation.

W. H. WILLIAMS, e '96, the first business manager of the Wisconsin Engineer, announces that his address is now Stevensville, Mich.

S. D. WONDERS, c '13, was married on October 16, 1920, to Miss Dixie Ward Braley, at Newark, N. J. Mr. and Mrs. Wonders are living at 1007 W. Exchange St., Akron, Ohio.

D. M. WORKMAN, m '10, is an engineer with W. Baehr, consulting engineer, 2013 People's Gas Bldg., Chicago, Ill.

OLIVER B. ZIMMERMAN, m '95, M. E. '00, has made public the complete success of the International Harvester Company in making a substitute for gasoline. This process will have a marked influence on the quantity production of gasoline because of its wider application than any other present process.

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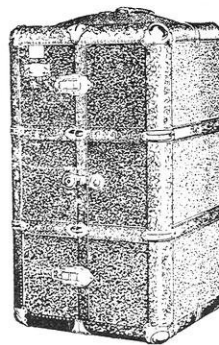
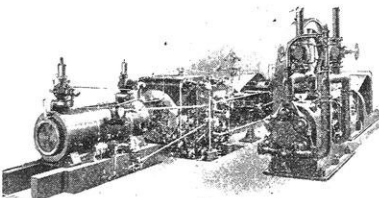
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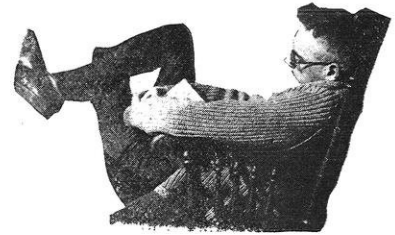
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CAMPUS NOTES

By FREDERICK W. NOLTE



Spring has come.

Evidence is not lacking. No less than sixty-four robins have been sighted. The little boys are all playing base ball, and the little girls hop-scotch. The co-eds are wearing more clothing, and the hibernating lawyers have come out of their winter quarters.

However, we still retain the heavies. Every time we change, the weather has a relapse.

HIGHWAY INSPECTOR'S SCHOOL

The Wisconsin Highway Commission, under the direction of Mr. E. M. Balsley, chief of the Inspection Bureau, conducted an inspector's school in the Engineering Auditorium on the evenings of March 22 and 23. The meetings were well attended by interested students. The instruction consisted of lectures by various engineers in the employ of the state. The Highway commission has a large program before it for the present construction season. It is estimated that Wisconsin will build a greater length of concrete pavement this coming season than any other one state. The officials in charge feel that, without adequate inspection, satisfactory work cannot be obtained through the contract system. Furthermore, they desire to obtain accurate costs of materials, grading, paving, and other items of highway expense, and believe the inspector is the logical person to gather it. An examination is to be conducted later to enable the commissioner to get a better idea of the men suited for the work.

The engagement of Helen W. Burch to Harry I. Miller, Senior E. E., has been announced. The wedding is to take place next summer. Congratulations, Harry.

The Engineering Faculty were entertaining Mr. Thum, associate editor of *"Chemical and Metallurgical Engineering,"* at a luncheon at the University Club. The conversation veered here and there. "The Schlitz Palm Garden was closed the last time I was in Milwaukee," volunteered Dean Turneure. "It hadn't a chance with booze cut out," added Professor Bennett. "You can't shake your shirt on tea," were the closing remarks of Mr. Thum. What's this academic seclusion stuff?

Prof. Orth, of the drawing department, announces the arrival of a son, Charles Dunlap, born March 9.

COMPETITION CLOSING FOR NELSON TROPHY

Unless competition is unusually close among all colleges, the winner of the Nelson Trophy for the current year should have more than 200 points. There is no one near that mark at present and the spoils may go to any one of the higher scorers as the table stands today. Owing to small scores being made by some of the colleges it increases the competition between the three or four leaders. As the score stands now it will be necessary for the winning college to take first in the three remaining major tournament of baseball, rowing, and track. If sufficient men will sign up, a soccer tournament will be run off, and it is essential that the college supervisors get their men out. In almost every final score the difference between first and second place is very small, last year only $3\frac{1}{2}$ points. Class I comprising the membership of the intercollegiate squads has been compiled to March 31st, and does not include the squads for baseball, rowing, outdoor track, or tennis which final compilation may change the places in this class. On April 1st the score stood in Class I as follows: L & S first, Engineers second, Commerce third, Agrics fourth, Medics fifth, and Law had no men competing in intercollegiate athletics. At present the score board shows the following totals: L & S 126, Engineers 118, Commerce 117 $\frac{1}{2}$, Agrics 64 $\frac{1}{2}$, Medics 54, and Law 6.

Is L & S to beat us by that score? Surely not. If you can row, play ball, or run, call L. C. Harvey, B. 192. Let's get the Nelson trophy again.

"Dave" McLenegan declines to discuss the pros and cons of timing his car. He claims that half of this magneto talk is all Bosch, anyway.

Dean Marston's story of the levelman who took a benchmark on a box car, brings to mind the case of a frosh who brought back his level to Prof. Owen with the complaint that it had no cross hair. "How come?" asks Owen. "Well, I couldn't see them," said the frosh defensively. "I even took the end out of the telescope and felt for them with my finger, and there's nothing there at all." Business of Owen chasing the frosh into the lake with a red-and-white range pole.

Prof. "Pat" Hyland denies emphatically the rumor that the Department of Machine Design has purchased an English bull dog to be used as a model of a flat faced follower.

With more than twice as many points as their nearest competitors the Engineers won the Intercollegiate track meet held Saturday, March 26. The final scoring was: Engineers, 51; Commerce, 23; Agr'cs, 15; and L. and S. 14. Our team was captained by Harry Phillips, junior mechanical, and was composed of the following men:

Shot put—Otto, Madell, Hamman, Aderman.

High jump—Gibson, Kinsey, Otto, Woods.

High hurdles—Kinsey, Hammann, Otto, Sternlieb.

Forty yard dash—Woods, Otto, Kernan, Pfeifer.

Mile run—Powell, Phillips, Lewis, R. W. Taylor.

Low hurdles—Sternlieb, Otto, Shoemaker, Pfeifer.

Half mile—Stewart, Rosecky, Wehrs, Phillips.

Broad jump—Kinsey, May, Woods, Gibson.

Two mile—Powell, Greeley, Seewart, Nelson.

Quarter mile—Wade, Rosecky, Chambers, McArthur.

Pole vault—Hammann, Tomlinson, Schmidt, Krieger.

The Engineers took first in all events except the forty yard dash, and low hurdles, in which they placed second.

When Professor Gallalee spread the quiz papers before his junior civils in steam and gas, with the remark, "You fellows don't want these grades," in the fervent language of the campus, he said a mouthful.

ISN'T THE DISTINCTION A TRIFLE INVIDIOUS

Prof. Terry (in Physics, speaking of Joule's chances to do research work): "Joule was lucky. His father owned a brewery so that Joule didn't have to work or teach school for a living."

The University Extension Division is now conducting several sophomore, as well as freshman, engineering classes in Milwaukee. While the classes are primarily for Soldier Bonus Students, they are open to any student who can qualify for entrance to the College of Engineering. The present home of the Extension Division, 471 Van Buren Street, is not equipped with laboratory facilities, and this necessitates that all shop and laboratory classes be held in the Milwaukee Trade School. An exceptional feature of the engineering classes conducted by the Extension Division is that they extend full credit toward a degree, which is not the case in any of the other courses.

Say, wouldn't you like to fuss our "sister" engineer? Honus made a darby of a girl in the parade; but he says it is all bunk to try and imitate the women. First of all, men gaze at you so peculiarly; secondly, you feel so loose in their clothes; and, thirdly, the scarcity of their attire is enough to kill a mere man. At least so it was with Honus. After the parade he went to bed with a cold, cursing women and all their wear.

"What's New in Metallurgy," was the subject of a lecture given on March 25th in the Engineering Auditorium by Mr. Ernest E. Thum, associate editor of *Chemical and Metallurgical Engineering*.

The Mechanical Engineers Bowling Team, consisting of Pat Hyland, Dahlberg, Keown, Shields, and Van Hagan, finished first in the Faculty Bowling Tournament, which closed on March 26, with a record of 26 games won and 14 lost. The Ag team took second, the English team third, and the A'l-Engineers team, under Captain Jimmie Watson, ended in fifth place.

The rich store of bowling talent which the Engineering school possessed led, some years ago, to the division into two teams. As a result of this division, the Engineers heretofore were never successful in their attempt to finish in first place. Last year the Mechanicals finished third.

The consensus of opinion of the Juniors, as expressed in Engineering Seminar, is that the word "bibulous" is an adjective, signifying that the person to whom it is applied is addicted to—bible study.

Prof. Van Hagan, (giving his philosophy of life), stated, "Life is a series of events. A man in a backwoods town might be old in years but a child in his ideas because his life has been monotonous and uneventful. The greatest event in his life, perhaps, was the time Cy Jones' bull broke through the fence or the time he fell down the cellar steps." That, by contrast, reminds us of the town roustabout, who had been in many a drunken brawl, and had had more than one fight with the police. He was relating his experiences to some of the younger generation, and wound up his story by saying, "Boys, I'm fifty years old, but I've lived a hundred."

WHAT DO YOU MAKE OF THIS, WATSON?

Prof. Vic Lenher spends his spare moments tinkering with the flivver. After a recent session, in which he managed to get himself and his overalls well greased and generally filthy, he went into the kitchen, where his wife and the maid were preparing supper. At sight of him, the maid turned up her nose with a sniff, and said vehemently, "I hates the very sight of a man in overalls and covered with dirt."

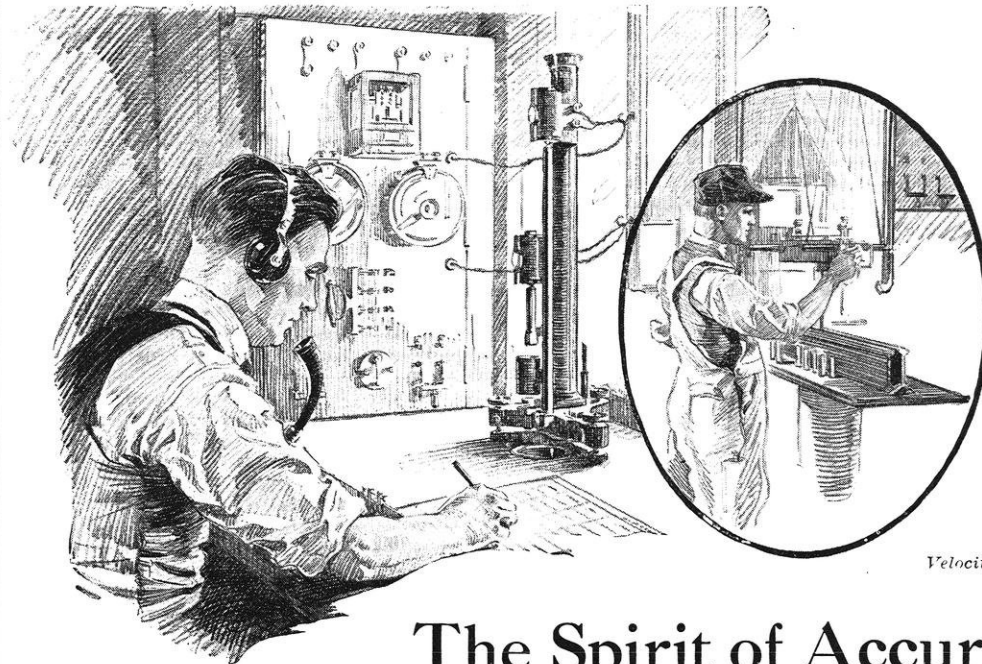
"Why Gwendolyn," exclaimed the professor, "You told us that you were engaged to a plumber. Why did you accept him if you feel that way about overalls and dirt?"

"I takes them that asks me," was the matter of fact reply.

Friend husband turned a startled glance on his wife, who offered no comment. He is still figuring on the proposition.

NOT KNOCKIN' OR ANYTHIN,' UNDERSTAND

From Geology 5c Lecture: "The Igorotes, or Philippine Islanders, built terraces in order to provide level land for the cultivation of rice. Scientists have found these people to be very low in the scale of civilization, but they made very good engineers."



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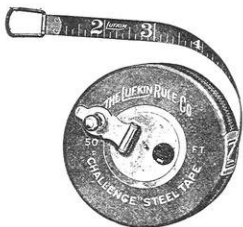
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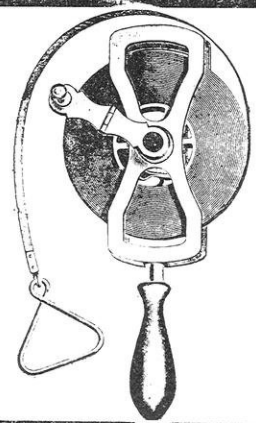
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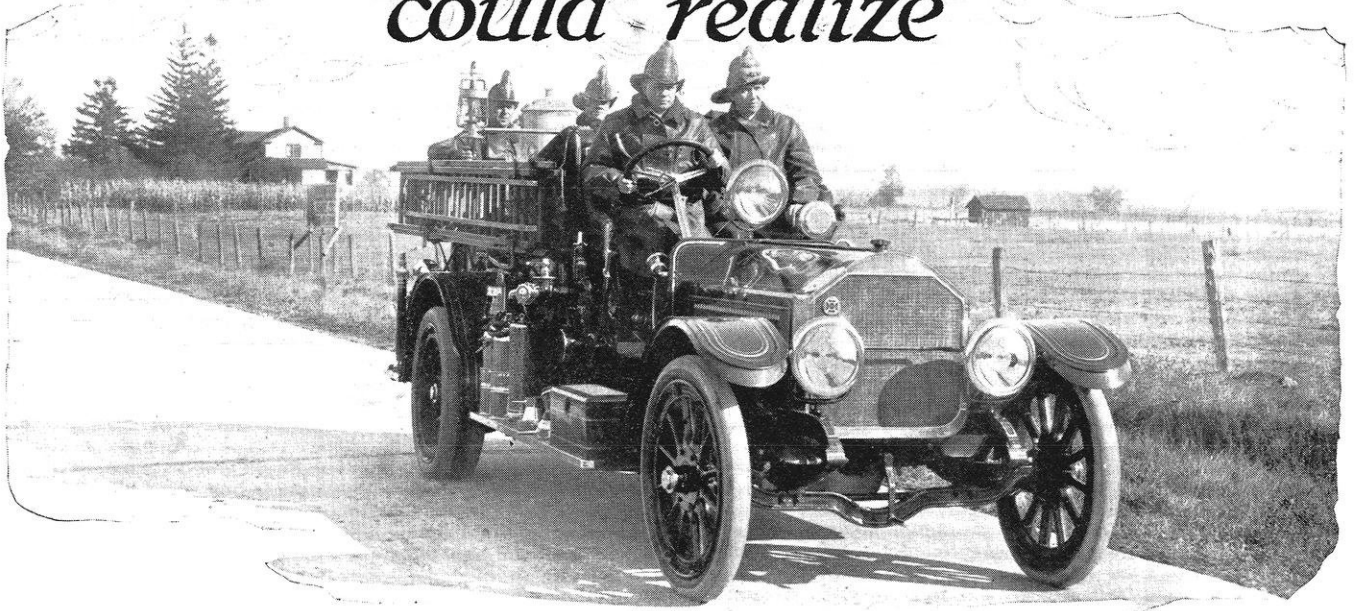
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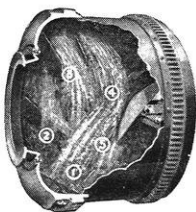
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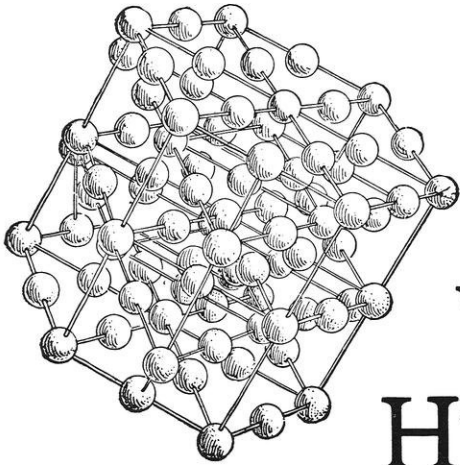
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HE was a young Oxford man, only twenty-seven when he was killed at Gallipoli. Up to his time, man had never seen the inside of an atom. He turned the X-rays on matter—not figuratively but literally—and made them disclose the skeleton of an atom just as certainly as a surgeon makes them reveal the positions of the bones of the body. Moseley proved that all atoms are built up of the same kind of matter. He saw, too, just why an atom of copper is different from an atom of gold.

Atoms are built up of electrons. Each atom consists of a nucleus, a kind of sun, with a certain number of electrons grouped about it, like planets. Moseley actually counted the number of electrons of all the metals from aluminum to gold.

When you discover what gold is made of or a new fact about electricity, you open up new possibilities for the use of gold or electricity. For that reason the Research Laboratories of the General Electric Company are as much concerned with the "how" of things—atoms and electrons, for instance—as they are with mere applications of the electric current.

Hence Moseley's work has been continued in the Research Laboratories, with the result that more has been learned about matter. How does water freeze? What is lead? Why are lead, iron, gold and tungsten malleable? Such questions can be answered more definitely now than ten years ago. And because they can be answered it is possible to make more rapid progress in illumination, in X-ray photography, in wireless telegraphy, and in electrical engineering as a whole.

There would have been no coal-tar industry without the vast amount of research conducted in organic chemistry, and no electro-chemical industry without such work as Sir Humphrey Davey's purely scientific study of an electric current's effect on caustic potash and caustic soda. Sooner or later research in pure science always enriches the world with discoveries that can be practically applied. For these reasons the Research Laboratories of the General Electric Company devote so much time to the study of purely scientific problems.

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