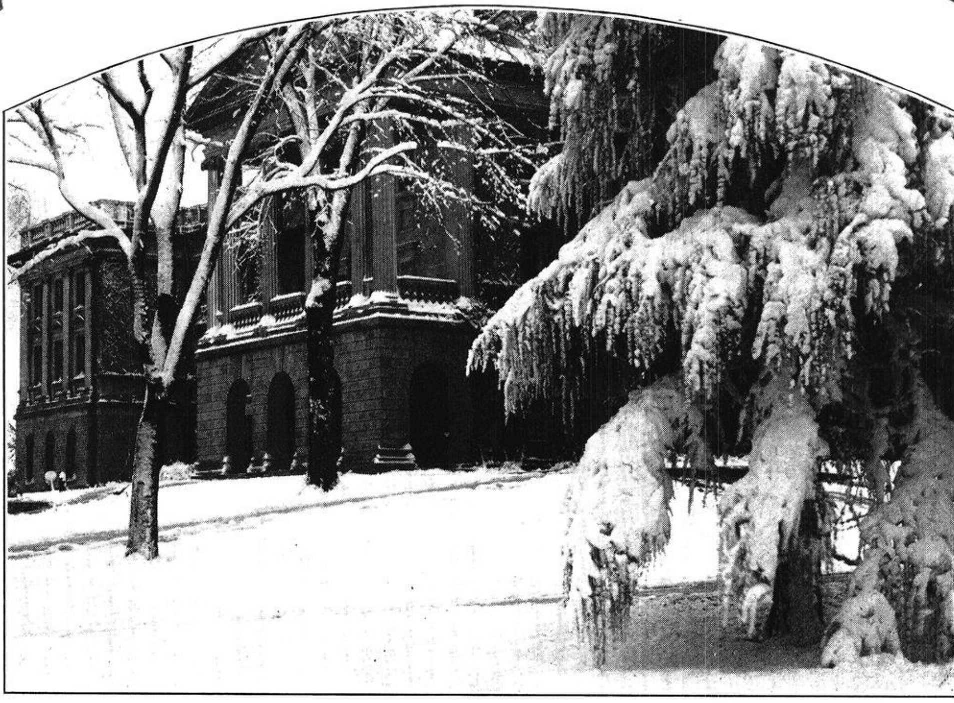
The Wisconsin engineer. Volume 34, Number V February 1930

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

The WISCONSIN



BASCOM HALL

ENGINEER

MEMBER of ENGINEERING COLLEGE MAGAZINES ASSOCIATED

PUBLISHED BY ENGINEERING STUDENTS UNIVERSITY of WISCONSIN

VOL. XXXIV, NO. V

FEBRUARY, 1930

The WISCONSIN ENGINEER

Founded 1896 — 25c per copy; $1.50 per year

Published monthly from October to May, inclusive, by
THE WISCONSIN ENGINEERING JOURNAL ASSOCIATION
306a Engineering Bldg., Madison, Wis., Telephones University 177 - 277

CONTENTS

VOLUME 34 — FEBRUARY, 1930 — NO. 5

The WISCONSIN ENGINEER

VOLUME 34, NO. 5 FEBRUARY, 1930

Making Engineers Effective

Some Thoughts on Engineering Education

By Sidney J. Williams, g'08, C. E.'15
Director, Public Safety Division
National Safety Council, Chicago

MOST engineers admit that the world would be better managed if they and their fellows had more to say about it. They don't get over a pained surprise that so large a majority of the seats of the mighty, both governmental and other, are occupied by lawyers, business men and the like. And, with characteristic objectivity, engineering educators and alumni have not hesitated to turn the searchlight on themselves and ask what is wrong. Questionnaires have been diligently circulated and conscientiously answered; faculties have conferred with graduates. Employers have said that they wanted young men with "leadership" rather than with higher mathematics. Deans, a bit puzzled, have observed that leaders are born rather than made. Finally the Society for the Promotion of Engineering Education has undertaken its very exhaustive and most commendable investigation.

Sidney J. Williams

What Is Wrong . . .

Admittedly there is something wrong with engineers or with their place in the modern world. What is wrong, and why?

I submit that present-day engineering education is largely to blame; that it is one-sided and often sends the young engineer out into life with a warped perspective which may seriously handicap him in his pursuit of success and happiness. *And* that this defect of engineering education can be remedied.

Working With Facts . . .

What is the outstanding characteristic of all real engineers? Clearly it is a reverence for facts — meaning physical facts. The young engineer in college and the older engineer in practice, when they face the problem of designing a bridge, a disposal plant or an airplane, give sole thought to discovering the facts of the situation and executing the design in accordance with these facts and with the laws of physics and chemistry. If two research engineers disagree as to some fact of electronic behavior they do not engage in public debate or in Wall Street warfare; they go back to their laboratories and seek for more facts.

As a result, the confidence of the general public in the reliability of engineering judgment *in our own field* is almost appalling. That is our strength and our glory, and no true engineer would think of permitting the slightest lowering of our high professional standard of reverence for facts.

But are there no facts except those of the physical sciences? For the young engineer in love, the "yes" or "no" of his beloved is the most important fact in the world. Later, the fact of having or not having a job, of receiving or missing promotion and an adequate income, are of vital importance to the young engineer. The supreme facts of human life thus reside in the interaction of personalities.

Surely no argument is needed to demonstrate that engineers find their most difficult problems in their relations with other men rather than in the laws of mechanics or the forces of nature. Read the lives of the great railroad builders, of the pioneers in any of the newer branches, even of the "pure" inventors. Were not their decisive successes the successes of courage, resourcefulness, diplomacy, mastery of flagging bodies and spirits?

The Personal Qualities . . .

Come down to lower levels. The young engineers does not progress very far before he encounters the need of "selling" his opinions and ideas to some one else—a nontechnical employer, a prospective client, a board of directors or what not. And how often, how tragically often, has a perfectly sound idea, a perfectly competent engineer, remained "unsold" through sheer blundering awkwardness! How often has an engineer of the highest qualities seen promotion go to a rival—successful because he "knew how to get along with people"!

It will hardly be questioned that these personal qualities unrelated to chemistry and physics are vital to the happiness and success of the engineer. But what has this to do with engineering education?

As has already been intimated, many engineers make the mistake of assuming that the only facts which require attention are physical facts. That is far from true. There are biologic facts, psychological, social, economic facts. The last-mentioned are beginning to receive some attention in the training of engineers, the others hardly at all. The most important of these, from the standpoint of the present inquiry, are the facts that have to do with the influencing of human behavior.

Influencing Men . . .

There is certainly an art, and there is the beginning of a science, of influencing human behavior. The art is well understood, or at least practiced, by every lawyer, minister or physician. It is taught in schools of law and of theology — to say nothing of the "psychology of advertising" and other commercial applications. No budding Blackstone hangs out his shingle without having received instruction in the art of persuasion as well as in the science of legal analysis. Nor does he employ this art solely in moving juries to acquit the guilty; he uses it equally in effecting friendly settlements, in "engineering" a business consolidation or in achieving any sort of leadership in his community.

We engineers, generally speaking, shut our eyes to all this. The student by his very choice of an engineering course gives evidence of his fondness for the field of physical science as contrasted with human relations. In our proper ambition to develop further his knowledge of and his reverence for physical facts, we too often do him the great dis-service of stunting whatever ability he may possess in the human field. By constantly directing his attention to the laws of nature we lead him to have less and less regard for the laws of human nature. Thus we, unwittingly of course, gradually develop in him the feeling that a thing is so if the laws of physics and chemistry say it is. Long afterward he learns, often tragically, that a bridge is not "so" until the board of directors of the railroad company says it is so.

In the Engineering College . . .

Why should not our engineering colleges impart the rudiments of the social as well as the physical sciences? I am not speaking of cultural education, and certainly I am not advocating an output of high-pressure go-getters, I am asking only that we give the young engineer, so far as we can, *all* the tools that he needs in his career.

Teach him the laws of physical motion, but teach him also the first law of human motion or action — namely, that "no appeal to a reason that is not also an appeal to a want is ever effective." Teach him to present his case not from his own point of view but from that of his listeners; to discover the unspoken reasons for the opposition of those whom he is trying to convince and to dispel the ignorance or prejudice on their part which is the real obstacle to his success. Teach him something about the underlying motives and influences that lead men to action.

This does not mean any revolutionary change in the present curriculum. It means perhaps omitting some of the more highly specialized courses — specialties in which one's real education begins after graduation in any case. It means the study of English composition, not from the standpoint of classic style but as a medium of arousing interest, conveying information and persuading to action. It means elementary instruction in public speaking from the same standpoint, which includes "public speaking" to one or two as well as to a thousand.

It means a course or two in modern applied psychology, and another in business economics. It means class projects in designing (for example) a water-supply system as a combined business and engineering problem, and then demonstrating its worth to an assumed board of directors or city council. It means studying the lives and deeds of eminent engineers and analyzing the qualities which made them great and the methods by which they achieved success. It means presenting to the young engineer the requirements and possibilities of the functional divisions of his profession — research, design, management, sales, and the rest. It means discussion of all these matters in the student societies.

And it means that those who direct this work must themselves be well-rounded men who understand both their subjects and their students.—*Engineering News-Record.*

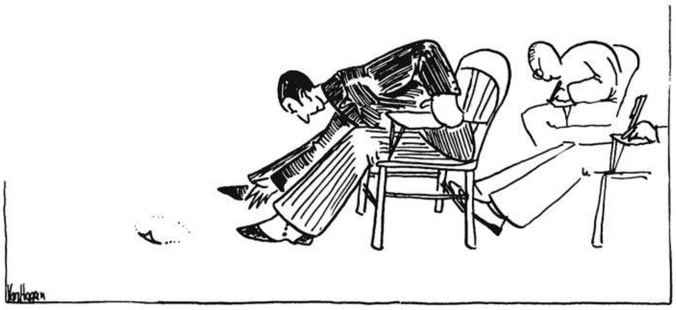
A Great Economic Waste Has Been Removed By Engineers Through the Discovery of a

Two Dimension Paper

WALTER T. WILSON, m'30

WUXTRY! wuxtry! A revolutionary discovery has been made in the paper industry! The *Wisconsin Engineer* is indeed fortunate to be able to give to its readers a description of this recent development, which is only now being presented to the trade papers.

One realizes how wasteful it is to write on only one



The art of cribbing will now become a science.

side of the paper for reports, themes, and so forth. There is an enormous waste in the use of two sided wall paper, when only one side is in active use. Only one side of wrapping paper serves any purpose. A one sided paper has been developed. It has only two dimensions — two dimensions broad by a half dimension thick $(2 \times 2 \times \frac{1}{2}) = 2$.

At first the paper was produced merely by splitting ordinary tissue paper. It is simple to see that that procedure involved several difficulties; so a second method was tried. A Hyland paper-stretcher was used to extend the paper to infinitesimal thickness. This was a great improvement, but was not quite satisfactory. The third method (this may sound like fiction, because three is the common poet's and fairy tale number), and the one to be used in the near future in actual production, is to make the paper quite like any paper, only using single rollers instead of pairs of rollers. Of course ordinary three dimension pulp will not do. The leaves of the African onion are quite satisfactory if first boiled in a dilute solution of hydrogen hydroxide. Jack Lacher, the chemical engineer, has developed a simple process for the production of this chemical on a large scale.

One of the great advantages of this new paper is its extreme lightness. Some interesting elementary calculus was used in computing the weight of a pile of this paper. This was done as follows:

Thickness $= dx$, area $= y. z.$

Volume $= \int_{bottom}^{top} yzdx$, Density $= D(1 - X^{2/3})^{3/2}$, where x varies from dx to zero.

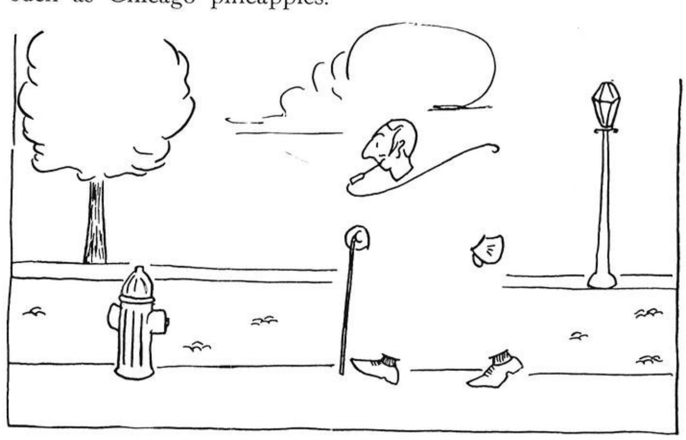
Thus when x is zero, the density is D, or unity. When x is unit thickness, dx or 1, the density is of course zero. Therefore

the total weight $= \int_{bottom}^{top} Dyz\ (1 - X^{2/3})^{3/2}dx$ This expression is easily integrated, and becomes:

$$W = \frac{\sin^{-1} D \sqrt{t} - be^{x5/3}}{\log yz} . i^3.$$

The i is evidence of the paper's weight being imaginary on the absent side, or wrong side. The log in the above expression is, of course, the same one the paper was made of. Thus it is seen that this one sided paper being so thin and light reduces shipping expenses. In fact it is so light that one can notice it glow at night. If experiments now being conducted are successful, we will be able to obtain quite strong light by using several thicknesses, that is, of course, with the real side out. Perhaps you and I will see the time when this paper is used for walls and ceilings, and old fashioned mazda lamps will be passe.

If an object is wrapped in this paper with the wrapping wrong side or imaginary side out, the outfit becomes invisible. This will be quite popular for surprise packages, such as Chicago pineapples.



A suit of two dimension paper with the wrong side out.

If two sheets are pasted together with the wrong sides out, secret messages can be sent easily. John Jones and Syl Guth, of the army, are conducting secret investigations along this line. Perhaps we will soon have invisible cribbing ponies to add to our instructors' worries. Then, again, they might dissolve particles of this paper and use it for invisible ink to write our exam questions with. They could flunk us easily if we couldn't read the questions.

(Continued on page 186)

The Modern Method of Utilizing That Great Source of Energy

Wind Power*

By ALBERT C. SCHAEFFER, c'30

WIND power is not generally considered as of much practical importance. There are two main reasons for this. The velocity of the wind is continually changing, and when the wind velocity is normal there is not a great deal of power available. Although it is true that the wind does not deliver continuous power, the condition is not so bad as is believed. Some means of furnishing power during the periods of calm is used in conjunction with the windmill. This might be a set of batteries, which could be charged when the windmill is running at capacity; or an auxillary engine; or a reservoir, which could be pumped full by the windmill.

At seven weather observation stations in the South and West it was found that the wind velocity exceeded 4 miles per hour for 7,500 out of 8,760 hours, and that the most prevalent velocity was 15 to 17 miles per hour. In the East, weather observations show that the most frequent velocity is 11 to 15 miles per hour. The longest period in which the wind velocity remained below 5 miles per hour was 34 hours. Five miles per hour is about the minimum speed that can be economically used.

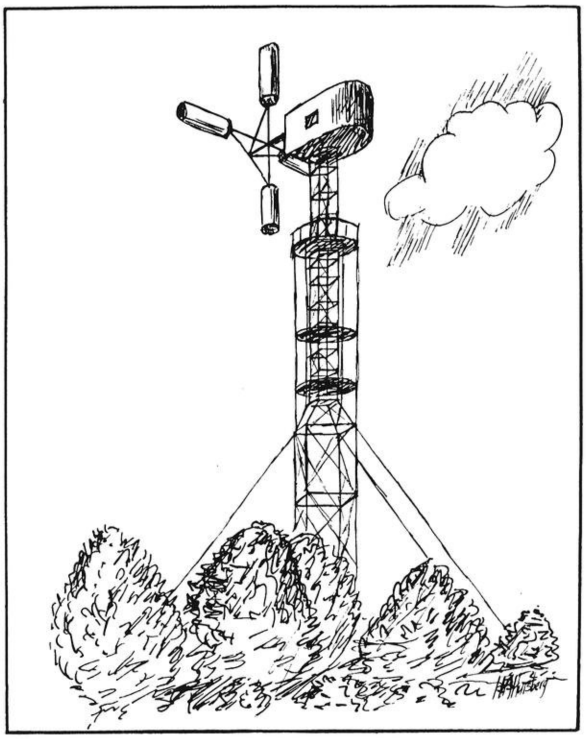


FIG. 1. *A Flettner rotor type of windmill at Nauen, Germany.*

There are 100,000 windmills sold in the United States each year, but few of these generate more than 10 or 15 horse power. Although windmills are one of the most ancient devices for obtaining power, they have received little scientific treatment. This is truer in the United States than in Europe, where windmills have received more attention. The old Dutch windmills were only 4 or 5 per cent efficient. The American windmill, although leaving room for improvement, is better. An aeroplane blade type windmill has been tried, using two or more blades, and has given satisfactory results in some cases.

In Montana one of the railroads uses a windmill to generate the electricity that operates the signals on a 26-mile stretch. It is the aeroplane blade type, and has given continuous and satisfactory service.

Experiments are being carried out upon other types of windmill. A device being tried in California consists of a fan in a large tube, with a funnel on the windward end. The whole thing is mounted on a circular track so that the funnel can be turned with the wind. This windmill will generate power at wind velocities as low as 4 miles per hour. When running at capacity the speed is 180 revolutions per minute and 200 horse power is generated. It is planned that a dozen of these mills will be constructed within a radius of 50 or 100 miles, with the idea that the wind will never die out completely over the entire area and that 1400 horse power will be delivered continuously by the group. The cost of operation will be small because all the control is automatic and one man can handle the entire group.

A windmill has been built recently which operates on a new principle known as the "Magnus effect". A number of years ago Professor Magnus experimented on the effect of a rotating body in a moving fluid. It is this effect that causes a baseball to curve. When a rotating body is placed in a fluid that is in motion relative to the body the velocity of the fluid is increased by the rotation on one side, and decreased on the other side. This difference in velocity causes a force to act on one side of the body approximately at right angles to the direction of the fluid.

The Flettner rotor operates on the "Magnus effect". The Flettner rotor is simply a large cylinder exposed to the wind and rotated about its axis by a machine. It was used instead of a sail on the ship Baden Baden, and proved successful even in the severest storms on the North sea and Atlantic ocean. The power required to turn the cylinders is only about 10 per cent of the power taken from the wind. The force of suction on one side of the cylinder is about 80 per cent of the total force and the pressure on the other side constitutes the remaining 20 per cent. It proved more efficient than any propellor blade or sail, and was equivalent to a sail of 10 times the projected area.

*Written for the course in Engineering English.

At Nauen, Germany, a windmill was built using four Flettner rotors as the blades on the wheel. This mill will deliver power at wind velocities of 7 miles per hour or greater, and records kept for 3 years on a radio tower nearby show that the windmill will be able to generate power 90 per cent of the time. The diameter of the wheel is 65 feet 8 inches, and the 4 rotors have an outer diameter of 35½ inches and an inner diameter of 27½ inches. Each cylinder is 16 feet 5 inches long and is made of aluminum 1/32 inch thick, Fig. 1. It is connected, using a 1:100 speed ratio, to an electric genreator which delivers constant voltage over a large range of speeds. An oil engine was used to furnish auxiliary power when needed.

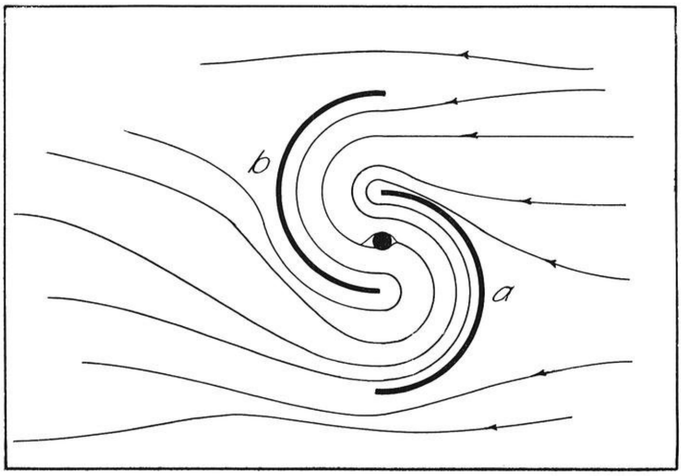


FIG. 2. *Wind blowing on rotor (a) causes a vacuum effect in the inside of that rotor which works against the wind force on rotor (b), thus causing a weak twisting moment.*

The ratio of peripheral speed to wind velocity is about 2½, but this varies with the wind velocity. As the wind velocity increases above the rated velocity, the ratio of peripheral speed to wind velocity decreases, acting as a sort of automatic speed regulator. The velocity at which the wheel rotates also depends on the rate at which the cylinders are rotated. In this way when the wind velocity is more than enough to run the machine at rated capacity the cylinders can be slowed down, and the wheel will not run above rated speed. In order to experiment on this method of controlling the output of the windmill, a variable speed electric motor was used to run the cylinders. The experiments showed that it was practical to control the output of the windmill by changing the speed of the rotors, and if another windmill is built some less expensive method of running the rotors and controlling their speed than an electric motor will be used.

This question of output regulation in a wind of constantly changing velocity is important. The power of the wind varies as the square of the diameter of the mill wheel and as the cube of the wind velocity. The available power of the wind, therefore, varies a great deal more than the wind velocity, and it would not be economical to build a windmill that could use the maximum power available at the greatest wind velocities. In the rotor windmill the speed of the cylinders is decreased in high winds, and in the blade type of windmill either the blades are turned to let the air through more easily, or a fin is used on the end of each blade to set up vortices in the air and thus cut down the force on the blades.

The rotor type of windmill constructed at Nauen, Germany, proved successful and a larger one will be built. The new windmill will have a wheel 100 feet in diameter mounted on a tower 265 feet high. The maximum power will be generated at wind velocities above 22½ miles per hour, which will be 136.5 kilowatts. The main Flettner rotors are 24 feet 8 inches long and have an outer diameter of 5 feet 11 inches and a diameter at the inner end of 4 feet 7 inches. A 1:150 speed ratio will be used. Instead of using an electric motor to turn the rotors a less expensive device, the Savenius rotor, will be used, and thus the wind will furnish all the power.

The Savenius rotor also operates on the Magnus effect and was invented by Sigurd Savenius, a Finnish engineer. When two semi-cylinders are fastened together as shown in Fig. 2, the air pressure on one-half is almost balanced by the suction on the other half and the twisting moment is weak. If the two semi-cylinders are shoved together, Fig. 3, leaving a small opening for the air to pass, the region of vacuum becomes a region of pressure and the torque is trebled and the speed increased to 1.7 times the original velocity. There is also a strong Magnus effect upward due to the displacement of the lines above the rotor.

The Savenius rotor can be used with its axis either vertical or horizontal. Two rotors with vertical axes were compared with a windmill of the conventional type having the same projected area as the motors. The windmill had a wheel diameter of 27.6 inches and used 18 vanes, curved 44 degrees at the base and 15 degrees at the outer end. The first rotor to be tried consisted of two semi-circles with the passage between them one-fifth of the spread. The other rotor was made of two 165-degree sections separated one-

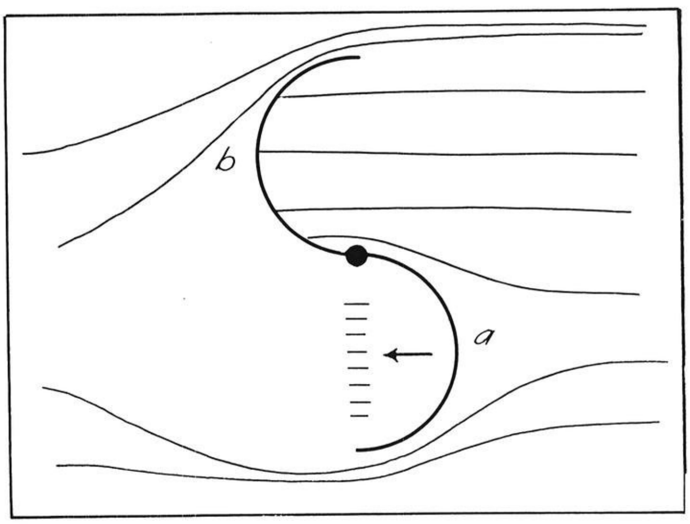


FIG. 3. *When (a) and (b) rotors are placed in the above position, the air currents striking (b) are deflected into the inside of (a) causing pressure on the inside. This has the effect of greatly increasing the twisting moment of the rotors.*

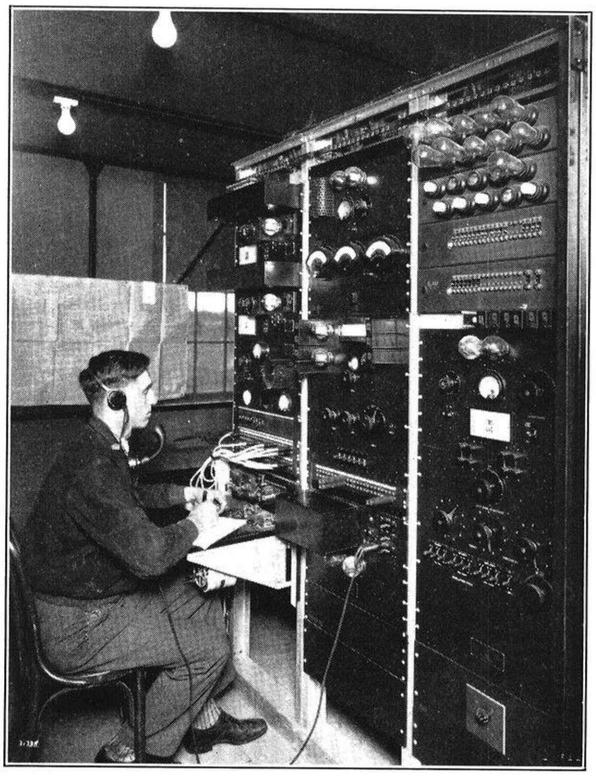
(Continued on page 181)

Telephony Between Ship and Shore

By R. A. HEISING*
Bell Telephone Laboratories

IN a demonstration on December 8 preparatory to commercial opening, telephone calls passed to and from the United States Lines' steamship "Leviathan." By the demonstrated system of wire lines and radio links, of a general type which has become familiar in its transatlantic application, passengers on the Leviathan can now converse with their friends ashore.

The new facilities are the outcome of a long series of experiments extending back beyond the time of the war. After early work on communicating systems to operate between war ships, a program of ship-to-shore telephone development was initiated in 1919. Radio stations for both transmitting and receiving were built at Green Harbor, Massachusetts, and Deal Beach, New Jersey, and corresponding equipment was installed on the coastwise steamers "Ontario" and "Gloucester" plying between Boston and Baltimore. Apparatus was ultimately designed which allowed these vessels, while at sea, to maintain two-way conversations with land telephones. Wave-lengths were in the broadcast range, and power levels were about one kilowatt in the transmitting antennas on land and one-quarter kilowatt on ship.



Operating the line terminal equipment.

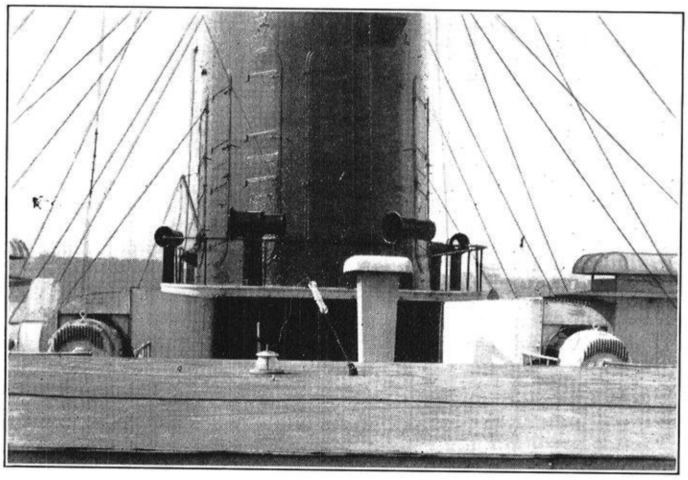
Work toward making ship-to-shore telephony available to the public was suspended in 1922. Though trials had been successful from a technical stand-point, the development was not carried to the point of the establishment of service to the public because conditions prevailing in the shipping world did not seem to justify the establishment of a commercial telephone service to ships. In the meantime progress in other applications of radio was bringing forth new methods and equipment, of which much was applicable to the ship-to-shore problem. Especially influential were the growing use of very short carrier waves and tuned directive antennas, of frequency control by quartz-crystal oscillators, and of high-power water-cooled vacuum tubes. When in 1929 ship-to-shore telephone development was resumed, it could build upon the Bell System's extensive experience with both broadcast and transatlantic radio.

Though in many ways similar, the problems of ship-to-shore telephony differ in several obvious and important respects from those of trans-oceanic telephony. Both ask point-to-point radio communication; but in the ship-to-shore case between points of which one — the ship — is moving. Space for apparatus and antennas on the ship is furthermore severely limited. Finally, resonance effects in metallic structures, interference by adjoining electrical apparatus, and persistent mechanical vibration, all escapable on shore, are inevitably to be dealt with on the all-steel, machine-packed vessel. Short waves were chosen for use, after extensive transmission observations on transatlantic vessels, and a survey of the available channels. Of the two paths which such waves may take between stations — that along the surface of the earth, and that upward to a reflecting layer and down again — the "ground wave" promised greater utility, at short distances. The reflected waves must, however, be used at greater distances. Field-strength surveys had shown that the absorption of ground waves by the earth's surface was considerably less over water than over land. To verify these results for shorter waves, and especially to determine absorption effects at the shore line, a further survey employed fixed receiving stations at Long Beach, Long Island, and at Nantucket; and a transmitting truck cruising near Deal. From these tests it appeared that stations transmitting and receiving to and from the sea should be located at the water's edge.

Short waves are amenable to directive transmission and

*R. A. Heising was an assistant in physics at Wisconsin from 1912 to 1914.

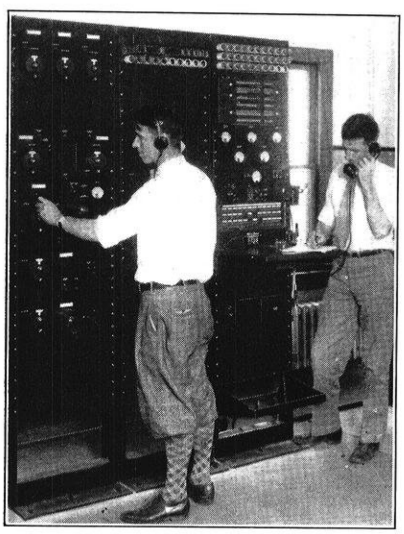
reception, but the use of directive antennas on shore is complicated by the motion of the ship. To avoid rotating the shore antennas so as always to point toward the ship,



The antenna used for transmission on ship board is a wire reaching upward and connected at its lower end to a lead passing through a bell shaped glass insulator into the radio house.

the land stations must be placed where the line of the ship lane intersects the shore. The choice of stations sites is thus quite restricted. Directive transmission and reception aboard ship is not feasible, for even were space available for rotating antennas to allow for changes in the ship's bearing, absorption and reradiation from the vessel's metalwork would be ruinous.

With modifications on these accounts, a system (similar to the transatlantic short-wave system) was put in experimental operation in August, 1929. The shore transmitter was one of the experimental ones at Deal which had been used for commercial transatlantic telephony; for measuring the reception on shore a receiver was installed at Elberon in a truck; for operation on the "Leviathan" apparatus was specially designed and built. During the ship's successive trips throughout the autumn, the system was tried out and modified, and the shore station was established in a permanent location at Forked River, New Jersey, on Barnegat Bay, where a set similar to those at Netcong was installed. In reducing the shore end to its virtually final commercial form all that now remains to be done is to install a transmitter at the ultimate site at Ocean Gate, New Jersey, five miles along the shore from Forked River.

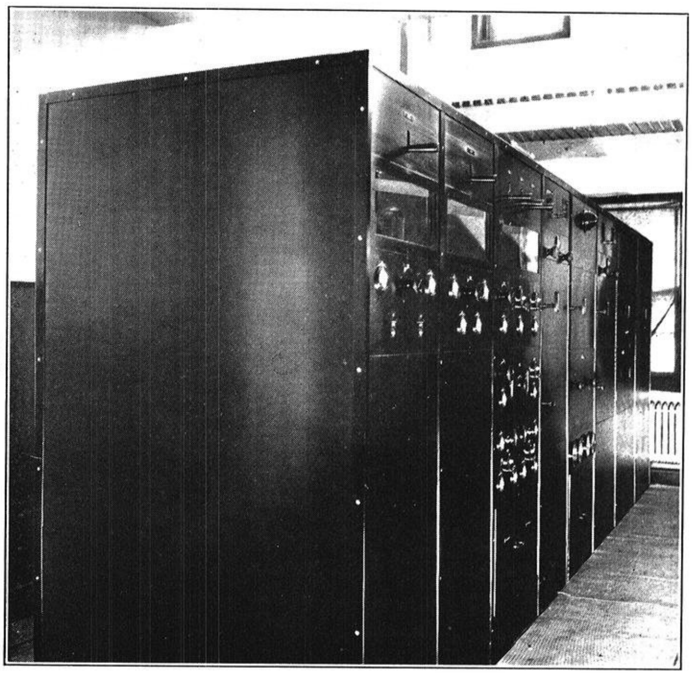


The shore receiver at Forked River, New Jersey.

The scheme of transmission involves the use of four different carrier frequencies: two of about 4200 kilocycles for transmitting in the two directions at short distances, and two of about 8700 kilocycles at longer distances. In the transmitters the output of a crystal oscillator is amplified and modulated by the voice currents. The carrier and both sidebands are radiated. In the receivers the incoming signals are demodulated in two steps, between which they are amplified and filtered of extraneous frequencies.

The apparatus by which this is accomplished ashore is the same as that used in the transatlantic service. Only in adapting it to the particular ship-to-shore frequencies has it been modified. Aboard ship the apparatus is somewhat more special. It is all located in a small two-room radio house on the top deck of the "Leviathan," midway between the second and third funnels. In the starboard room are the transmitter and its power supply; the port room, shielded from the other by copper mesh, contains the receiver and the line-terminal equipment.

The ship's transmitter is divided into two parts for operation at the two carrier frequencies; these parts are



The shore transmitter now at Deal.

independent save for their power supply common voice-frequency and power-amplifier sections and the transmitting antenna. In the shorter-wave part, a crystal oscillator (for which a duplicate is provided in reserve) supplies current at 4415 kilocycles to a harmonic generator which doubles the frequency. The 8830 kilocycle output of the frequency doubler is then amplified by two power-stages. The modulator, which consists of two 250-watt tubes, modulates the output of this amplifier by the voice currens. The radio-frequency signals pass out, for radiation by the antenna, through an antenna-tuning circuit which offers low impedance to the carrier and sidebands and high impedance to currents of other frequencies. The longer-wave part of the transmitter differs from the shorter only in the re-

(Continued on page 180)

Tunnel Alignment Work *of the* Pennsylvania Railroad Under *the* Hudson River*

By HERMAN L. CHASE, c'27

THE work of driving the Pennsylvania Railroad tunnels under the Hudson River required a precise control survey for its accurate alignment. The tunnels consisted of two parallel tubes or water-tight linings, 23 feet in diameter, driven through soft movable or unstable material. With precise instruments and exacting methods of procedure, and by frequent repetitions made necessary by settlement and movement of the lining, the survey was brought to a successful conclusion when under its direction, the linings of the tunnels driven from opposite sides of the river toward the center, coincided almost exactly.

Of the millions of people that yearly pass through the Hudson tubes on their way to or from New York, not one in a thousand has any idea of the complexity of the engineering problems that beset the men who planned and constructed those tunnels. The economic importance of this work in the improvement in the transportation facilities of the eastern part of the country can hardly be over-estimated. Yet we are not apt to fully appreciate that, since we have almost entirely forgotten how conditions were when the eastern terminus of the great Pennsylvania System was at Jersey City.

Direct passage under the Hudson River has made it possible for all passengers and freight, coming from the south and west, to be landed directly in New York, with no changes to ferries or rapid transit trains. These tunnels, in connection with others under the city, make it possible for freight and passenger trains to go through the city to and from the New England states with no unnecessary stops or changes.

One of the few technical details of this tunnel construction that has impressed the minds of those with only a limited understanding of engineering work is the precision with which the work started at one side of the river coincided with that started at the other side, when both met near the middle of the river. How two groups of men, each starting out of sight of the other, seventy feet under ground and more than a mile apart, can dig toward each other, and meet less than a quarter of an inch out of alignment, should be of interest to those who would like to know something of how great engineering projects are controlled.

The tunnel alignment work for the Pennsylvania tubes was not radically different from other jobs of this kind, in principle or in difficulty. However, one might claim it to have been difficult, since the work had to be repeated at intervals. This was because a large part of the material through which the tunnel was driven was soft and unstable, so that there was a very appreciable settlement and movement of the tunnel lining as a whole. The parts of the work that were repeated will be mentioned later.

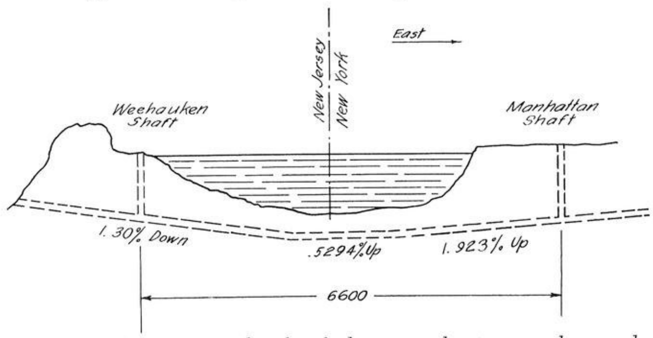


FIG. 1. *A diagramatic sketch of the ground, river, and tunnels.*

The construction consisted in the driving of two parallel tunnels, each 23 feet in diameter, and 37 feet apart, center to center. The tunnels were circular in section and were lined with cast iron segments bolted together, and two feet of concrete. The length of the tunnels is about two and a half miles, but little more than four thousand feet of this length was actually under the river The part that was under the river, and parts of the banks, made work expensive. Shields and the pneumatic process were used. Figure 1 shows diagramatically the profile of the ground, river, and tunnels. The maximum depth of the tunnels below the water level was about 97 feet.

As shown in Figure 1, there were two shafts from which the tunneling operations were started. It was necessary to establish at the bottoms of these shafts, and for each tunnel, monuments, or points, that would, by their position, give the exact direction in which the tunneling should proceed.

The establishment of the monuments at the base of the Weehauken shaft was a comparatively simple matter. When the excavation of that shaft was completed, a rectangular retaining wall was built of concrete, and of such dimensions that the copings of the east wall and of the west wall were about 150 feet apart. A point was set on the ground just west of the west coping and on the line of the north tunnel, and the transit was set up over this point. The instrument was oriented, or set in the line of the tunnel, by a sight over a similar point on the New York side of the river, 6000 feet away. Then the telescope was pointed down on each of the retaining wall copings, and brass plugs were set and center punch marks made defining

*Written for the course in Engineering English.

the exact desired alignment of the tunnel. These plugs were kept for reference. It was next necessary to transmit this alignment down 70 feet to the base of the shaft, so as

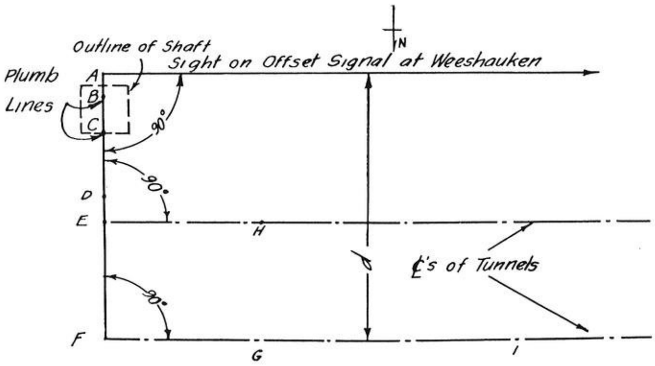


FIG. 2. *Establishment of base monuments.*

to set permanent monuments there. This was done by the use of long plumb lines of thin piano wire on which were hung especially heavy plumb bobs. The wires were lined in with the line of sight of the transit after the latter had been oriented. The transit was then taken below, set up and lined in by the plumb wires, and the permanent monuments were set as were the plugs set in the copings above. The monuments were designed to withstand the dangers that beset their permanency of location. Holes in the solid rock floor, a foot in diameter and about three feet deep, were filled with concrete in which were embedded brass plugs on which a center punch mark defined the exact point.

The establishment of the base monuments for the Manhattan shaft was not so simple a matter as it was for the other. The reason for this was that the shaft was not directly over the lines of the two tunnels. A different plan was followed (refer to Figure 2). Here we have shown the relative position of the shaft and the tunnels. The transit was set up a distance "d" south of the line of the north tunnel, and was oriented by sighting on a signal at the Weehauken shaft which was also offset the distance "d". A right angle was turned as indicated, and a plug set in the coping of the retaining wall for reference at D. Then two plumb wires were lined in as described before. The transit was taken below and lined in by the wires, while set at a point somewhere below "A". While lined in, in this position, the transit was used to set permanent monuments at E and F. Then with the transit set at E and at F, in turn, right angles were turned off as shown, giving the true alignment for the tunnels, and monuments were set at G and H.

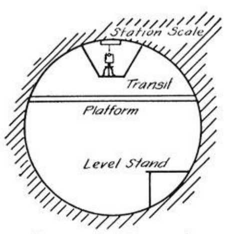


FIG. 3. *Vertical alignment.*

Thus far we have seen how the alignment for the tunnels was permanently established at both ends. From this point on, it was the duty of the engineers directing the work of tunneling to prolong these lines and thus direct the driving of the shields in order that they should coincide at the connection.

To prolong the line of the north tunnel, the transit was set up at the point G, and turned into line by back-sighting on F. The telescope was then turned over on its horizontal axis thus giving the line ahead, and the next station, I, was set. The transit was next moved to I from which point the line was prolonged again to the next station.

The vertical alignment of the tunnels was just as important as was the horizontal. The work was carried out by running precise levels through the tunnels. The bench

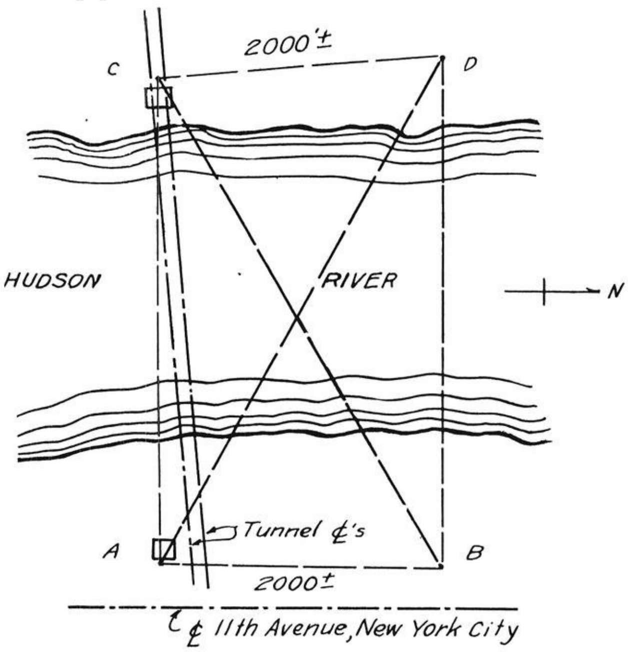


FIG. 4. *Triangulation of base monuments.*

marks from which the lines were started at each end were established by tide-gage readings at each side of the river. This method was checked by means of direct sights taken across the river in both directions. It is obvious that the relative elevations of the excavations must be very accurately known in order that they should meet. Figure 1 shows the grades that were determined as desirable before the work started. These grades were laid out by the leveling operations.

The final result of the survey control of the driving of the Hudson tunnels as a monument to excellent work in tunnel alignment. When the shields met near the center of the river, they coincided within 0.06 of a foot in elevation, and were even closer in horizontal alignment.

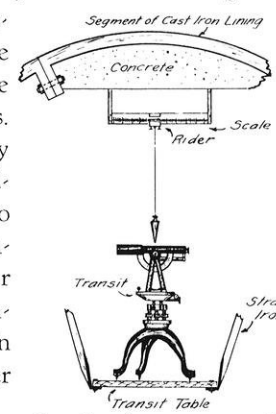


FIG. 5. *Arrangement of transit station.*

We have given in the foregoing only the merest outline of how this alignment work was done. As described, the work done was similar to most other jobs of tunnel alignment. We wish to give some idea of the refinements of apparatus and technique made necessary by the particular conditions encountered.

Methods of triangulation not previously mentioned were used in measuring the distance to be tunneled. The posi-

(Continued on page 182)

Editorials

DOCTOR OF PANHANDLING

WISCONSIN is the butt of Cartoonist Johnstone's humor in the New York Times of December 10, 1929. Taking as his text the news item that "Suit yourself studies" are planned for this university, he depicts our students struggling with their self-selected courses in Slumber, Saxophone, Co-eds, Forward-passing, and Haberdashery, and the final result of it all — a bum on a park bench with a big W on his chest and labeled Ph. D., or Doctor of Panhandling. The cartoon is far enough from fact to allow us to get a good laugh out of it, but close enough to what seems to be on some people's minds to induce thought.

The existence of a revolt against standard requirements for a degree cannot be denied. The spirit of the moment is a yearning for *liberty*. In terms of education, we interpret that as meaning the right to select our courses to suit ourselves and to do as much or as little work upon the selected courses as we please. There is considerable clamor about these matters, although one may be permitted to believe that the noise is out of proportion to the numbers who crave rights. The noise has had its effect upon those responsible for planning educational work.

We are told repeatedly that "education means learning to live." That is a broad definition that can mean anything. Another possible definition is: Education is a process of discipline. Our physical and mental faculties must be brought under control and made productive during this process. It would be delightful to both student and teacher if the necessary discipline could be self-imposed by the student. The enthusiastic teacher and the eager student constitute the ideal combination.

After trimming away the non-essential elements, we have left this point to be settled: Is any great proportion of our college youth capable of the amount of self-discipline necessary to carry them over the hard and discouraging phases of education? Unfortunately, human nature is so constituted that the individual who is capable of rigid self-discipline is rare. For every one who has the determination to drive through a tough job to the finish, there are hundreds, probably thousands, who habitually quit when the going gets rough.

Suit-yourself training may do for the so-called liberal education, but it makes little appeal to the man who is training for a profession.

"AS A MAN THINKETH — SO IS HE"

—Bible

As you think, you travel; and as you love, you attract. You are today where your thoughts have brought you; you will be tomorrow where your thoughts take you. You can not escape the result of your thoughts, endure and learn, be it base or beautiful, or a mixture of both, for you will always gravitate towards that which you, secretly, most love. In your hands will be placed the exact results of your thoughts; you will receive that which you earn; no more, no less. Whatever your present environment may be, you will fail, remain, or rise with your thoughts; your wisdom, your ideal. You will become as small as your controlling desire; as great as your dominant aspiration.

—James Allan

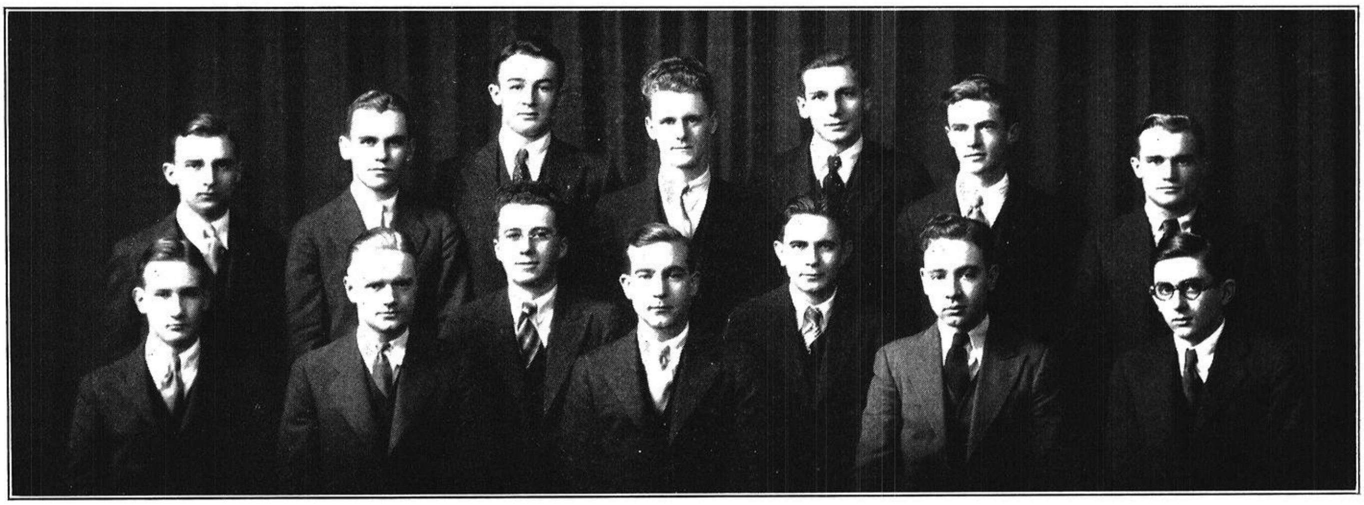
CIVIL ENGINEERS STIFFEN ENGLISH REQUIREMENT

A STIFFER policy toward the student whose English is below par has just been announced by the Civil Engineering Committee. The text of the policy appears elsewhere in this issue. For many years students in civil engineering have been required to take a course in English during each of the last four semesters of their course. Apparently the time has come when the requirements can be raised another notch. The student whose English is sufficiently crude will not be recommended for a degree until such time as he can satisfy the committee that he will not be a disgrace to the institution.

The new ruling, according to members of the faculty, is not intended to be applied recklessly nor in a wholesale fashion. The number of degrees that will be held up because of English deficiencies will be insignificant in all probability, but the moral effect should be considerable. There will probably be a greater interest in freshman English in the future and a keener desire to attain a reasonable mastery of the language.

The value of English to the professional man is no longer a moot question; it is accepted as established. Students, as a rule, accept the verdict of the practicing engineers on this point, but do not always make personal application of the finding. English as usually taught is an unpopular subject; teachers of English have not discovered how to make it appeal, and, as a result, students make no effort to attain to mastery. It is quite possible for a man to go through high school and through freshman English at the university and still remain practically illiterate. It is unfortunate that the threat of withholding the degree is necessary to accomplish what might, perhaps, be accomplished by better methods of teaching English, but the Civil Engineering Committee is taking the method that lies within its power. The experiment is worthy of attention.

"Papa! buy me a fur coat?"
"A pelt I'll give you!"



Top Row: J. H. Lacher, J. Trieloff, C. R. Lyneis, J. A. Strand, A. M. Huth, R. L. Van Hagan, J. A. Johnson.
Bottom Row: H. A. Hulsberg, T. H. Perry, L. W. Peleske, F. T. Matthias, W. H. Teare, R. S. Plotz, R. J. Poss.

CHANGE *of* STAFF

This issue of the *Wisconsin Engineer* is the last issue to be published under the direction of the old staff. The new staff, which will take over the magazine for the next year, will be headed by Theodore H. Perry, c'31, and Jack H. Lacher, ch'31. It has been a custom for several years for the Board of Directors of the Wisconsin Engineering Journal Association to elect the editor and business manager at the beginning of the second semester of each year rather than at the beginning of the year. This practice gives the new men a chance to become acquainted with their duties while under the direction of the old staff.

The *Wisconsin Engineer* is now publishing its thirty-fourth volume. For thirty-four years it has been in existence and, during that time, it has grown to be one of the leading engineering college magazines in the country. Its purpose has ever been to give the students of the engineering school an opportunity to become acquainted with the principles of technical journalism and to provide for them an opportunity to write for publication. We hope that we have been successful in our aim and we extend to the student body of the school of engineering a hearty invitation to participate in our activity and to help us make the magazine better and more representative of our student body.

The retiring staff thanks the student body for their co-operation and help during the past year. We trust that the new staff will enjoy even more the spirit of helpfulness which has characterized our administration, and that thereby they may be able to fulfill their obligation to the engineering college and the University.

A MONUMENT TO A GREAT ENGINEER

It is unusual and decidedly unconventional to build monuments for engineers. The works and masterpieces of technical men are monuments in themselves, and are generally more outstanding, more genuine and typical of the individual than anything that posterity can raise.

New Orleans, however, is undertaking the construction of a memorial plaza on the water gate, in honor of James B. Eads, an account of whose achievements appeared last fall in the *Wisconsin Engineer*. The jetties at New Orleans was one of Eads' foremost projects on the river. Back in the days when scientific design was in an embroyic condition, this great engineer built structures which have withstood the steadily increasing loading which they have been called upon to carry for nearly a century, and are still in working condition.

We hope that it will be a suitable memorial. It will have to be distinctive and outstanding if it is to be comparable to the achievements of this famous civil engineer of the nineteenth century. Eads' contributions will be a challenge to the best of memorial-builders.

DEAN FREDERICK E. TURNEAURE AWARDED MEDAL

Frederick E. Turneaure, dean of the College of Engineering of the University of Wisconsin has been awarded the Henry C. Turner gold medal by the American Concrete Institute for "distinguished service in formulating sound principles of reinforced concrete design." The medal is awarded not oftener than once a year for "Notable achievements or service to the Concrete Industry."

Dean Turneaure has an international reputation based on his study of the effect of moving loads on bridges. His text books on reinforced concrete design are used in many of the leading engineering schools in this country. His success and achievements should be an inspiration to engineers the world over and especially to the student engineers at the University of Wisconsin. We congratulate Dean Turneaure and hope that students of today may follow his example in serving the profession notably in the future.

Does the fall of night cause the break of day?

Alumni Notes

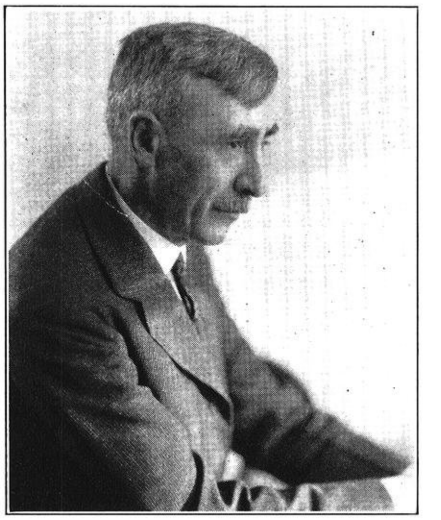
Successful Wisconsin Engineers
Frederick E. Schmitt

By Robert L. Van Hagan, c'32

Side by side with the achievements of the engineer runs the literature that records and interprets them. No one but an engineer can write that literature successfully, and yet it is not easy to find the engineer who can and will write. Wisconsin has been fortunate in producing a number of men who stand out in the field of engineering journalism. Dean among them, by reason of long experience and of his position as editor of *Engineering News-Record,* is Frederick E. Schmitt, Wisconsin '00.

Frederick Schmitt was born in Elizabeth, N. J., November 17, 1879. His parents moved to Wisconsin in 1880, and he received his preparatory training in Milwaukee schools. He entered the university in 1896, registering from Green Bay, and was graduated from the course in civil engineering in 1900. He received a master's degree in 1904. During his vacation periods, while at the university, he did some machine designing. Following graduation he took a job with the Berlin Iron Bridge Company at East Berlin, Conn., as draftsman and designer. He joined the editorial staff of *Engineering News* in 1902 and has continued with that paper and its successor, *Engineering News-Record,* until the present time. He was made editor in July, 1928.

The structural field has been Mr. Schmitt's chief interest, and his principal contributions to the magazine have been concerned with bridge and building work. He "won his spurs" in covering the collapse of the Quebec bridge in August, 1907. To quote from an account of this work: "He accomplished a journalistic feat that won country-wide recognition in the engineering profession by reporting the circumstances and causes of the collapse exhaustively and accurately in the first issue following the accident. The story was written in one continuous day-and-night session after his return from the scene of the failure. Out of this report developed a widespread agitation for the fuller study and improved design of large compression members, a movement in which he was an active figure." Other important assignments which he has covered include: the failure of the Austin (Pa.) dam, the Knickerbocker Theater roof collapse, wartime emergency ship-building methods and plants, the Florida hurricane, and the 1923 crisis in the Reclamation Service.



Frederick E. Schmitt

A number of years ago Mr. Schmitt carried out one of the first experimental investigations of the sway or vibration of high buildings, which led to the conclusion that the wall masonry was a controlling element in the lateral resistance of the buildings studied. He has been active in engineering societies, especially in the American Society for Testing Materials, the American Society of Civil Engineers, and the American Association of Engineers, and has served on a number of important committees.

In 1907, Mr. Schmitt was married to Ella Donaldson of New York City. There are two children.

CIVILS

Janda, H. F., C. E.'16, is joint author with G. M. Braune and William Cain of an article on earth pressure experiments on culvert pipes which appeared in the November, 1929, number of Public Roads. The experiments, which were conducted under field conditions, were carried on at a site near Chapel Hill, North Carolina. Fills of from 1 to 20 feet were used with both sand and clay and both flexible and rigid pipes. The articles should be of considerable interest to highway engineers. Prof. Janda, who was at the University of North Carolina when the experiments were under way, is now in charge of the Highway Engineering and City Planning courses at the University of Wisconsin.

Levin, Jacob D., c'27, has been working for the contractor on the new Montgomery Ward building at Chicago. He writes: "My work, aside from establishing lines and grades and supervising excavating and pile-driving operations, has entailed reporting quantities of work in place, checking subcontractors' monthly requisitions for payment, designing mixtures on the basis of the water-cement ratio, detailing form-work, plant layouts, and construction appliances, laying out important work, checking stone and steel drawings, and, in general, co-ordinating the functions of our foreman. Not the least of my responsibilities consists of approving quantities for subcontractors who have unit-price contracts, and also extras in the various subtrades."

Titus, William J., C. E.'13, chief engineer of the Indiana Highway Commission, is joint author with George A. Hool of an article on "Concrete Bridges and Structures" appearing on page 801 of the Engineering News-Record, issue of May 16, 1929.

Gates, Howard B., c'05, CE'15, is chief engineer for the Arthur McMullen Co. at 50 Church St., New York. The firm does a general contracting business. It builds the foundations and anchorages for the Hudson River bridge and the Kill van Kull bridge and has the contract for the Tri-Borough bridge.

Gardner, Harold W., c'05, has recently formed a partnership with J. C. Vivian for the practice of law in Golden and Denver, Colorado. Professor Gardner is head of the department of civil engineering at the Golden School of Mines and is a member of the faculty of the Westminster College of Law of Denver. Besides his degree from Wisconsin, he holds a master of science degree from the University of Kansas in 1911, and a degree in law from the Westminster College. He is at present city engineer of Golden and county surveyor of Jefferson county. He is also representative of Jefferson county on the Platte Valley Water Conservation League.

Haley, George G., c'05, who has been contracting since his graduation, is now contractor's equipment engineer and salesman for the R. E. Brooks Co., 50 Church St., New York.

Piltz, Russel J., c'26, is engaged to Miss Norma Hofferbert according to a recent announcement.

Pratt, Leo F., c'29, is engaged to Miss Marguerite Downie of Madison. Leo is junior engineer with the Inter-State Commerce Commission, Washington, D. C.

Preston, Burt K., c'26, was married on Nov. 11 to Mary Bonnefoey of Ottawa, Ill.

Smith, Leonard S., c'90, CE'95, former professor of City Planning and Highway Engineering here, and now City Planning Engineer of Redondo Beach, Calif., writes: "So far this winter the coldest weather has been 48°. Usually it is about 60° during the day. All we need is rain and that is promised soon." Address: Box 394, Redondo Beach, California.

Schrader, Roland P., c'26, has recently joined the engineering staff of the McClintic-Marshall Co., of Pittsburgh.

Hunder, Marcus B., who completed the requirements of the civil engineering course in February, has been appointed research assistant in Mechanics for the second semester.

Zander, Arnold S., c'23, former instructor in city planning, and more recently consulting engineer, has been appointed senior examiner for the bureau of personnel, formerly the Wisconsin civil service board.

Oakey, John A., c'28, paid a short visit to the college during the Christmas holidays.

Bliffert, Wesley P., c'29, is engaged to Miss Bonnie Potter according to a recent announcement.

CHEMICALS

Slichter, Donald C., ch'22, has recently returned to Madison from Toronto, Canada,, and is living at 2546 Kendall Avenue. He is with the Brittingham Company. In addition he is a member of the tngineering firm of Mason, Slichter and Gauld of Madison.

Manning, J. K., ex-ch'30, is sales engineer in the Chicago office of the Harnischfeger Corporation of Milwaukee. His engagement to Mary Elizabeth Winn of Madison has just been announced.

Kuehl, Carl A., ch'29, is attending M. I. T. Address: 294 Harvard Street, Cambridge, Massachusetts.

Mann, Charles A., ch'09, address: 35 Barton Avenue, S. E., Minneapolis, Minnesota.

MINERS

Knoll, Waldemar A., min'14, M. S.'22, writes about abolishing St. Pat's parade: "Don't get too genteel with your engineers, I always enjoyed the regular parade." Address: Anvil Location, Michigan.

Stengel, R. J., min'23, sends in a change of address from box 627, Pitcher, Oklahoma, to 63 West La Clede Avenue, Youngstown, Ohio.

ELECTRICALS

Fox, Gordon, e'08, who is now in Russia engaged in designing and constructing blast furnaces and steel plants, writes: "There is a great shortage of engineers in Russia and particularly of men experienced in modern practices. Russian engineers are well grounded in theory, but because there has been almost no new construction during recent years, they have not had practical contact with modern methods. Inherently they are as brilliant as the engineers of any other country. They are now being sent to Germany and the United States to study current practice. In the meantime the Soviet Republic has been obliged to call in foreign experts.

"If the American enginetr keeps faith, if only reputable and capable engineers are retained by the Russians at sufficient fees; if American engineering firms devote their best talent to Russian work, and if American manufacturers do not exploit the Rusisan market, but adhere to the Golden Rule, then America may expect to enjoy continued confidence and a liberal maesure of business. The opportunity is not devoid of responsibility."

Holder, Lyman F., e'26, is in the marine and aircraft department of the General Electric Company. He is especially interested in ship propulsion control at present. He also applies the Selayn indicating control to indicating of water levels. This device may be used over distances of two or three miles to reproduce exactly the movements of a dial.

Holm, Harold W., e'23, is with the Trojan Engineering Co., of New York City.

Leach, R. W., e'28, former business manager of the Wisconsin Engineer, spent the summer installing customer sub-stations for the Milwaukee Electric Railway and Light Company. His biggest job was for Nash Motors — 7600 K. V. A., 26,400 volt, 4 stations with underground loop system. Address: 253 La Fayette Avenue, Apt. 311, Racine, Wisconsin.

Mackin, Hugh F., e'28, is with the Wisconsin Telephone Company, 418 Broadway, Milwaukee. Address: 584 Marshall Street, Milwaukee.

MacRae, Norman D., e'28. Address: Hotel Gordon, Laona, Wisconsin.

Mather, Harold, e'27, is with the Wisconsin Bell Telephone Company at Milwaukee.

Paula, Milton W., e'28, is living at 4042 West Cullenton, Chicago, Illinois.

Porter, Frank M., e'24, is living at 209 West Walworth Street, Elkhorn, Wisconsin.

Post, George G., e'04, has been made vice-president in charge of power for the Milwaukee Electric Co.

(Continued on page 190)

Campus Notes

PI TAU SIGMA INITIATES

Pi Tau Sigma, honorary mechanical engineering fraternity, initiated 11 men Tuesday night, Dec. 17, at 5:30 in the graduate room of the union.

The initiates include: Alexander Cowie, '31, Glen W. Gibson, '31, Walter Karsten, '31, Raymond Mccreary, '31, Donald Miller, '31, Martin Mortensen, '31, Karl Peters, '31, Norbert Steckler, '31, Carlyle Steinke, '31, Charles Tannewitz, '30, and Newton Willis, '30.

A banquet was held at 6 p. m in the Old Madison room. Prof. G. L. Larson was the speaker, and Prof. Hyland acted as toastmaster. Orville Cromer, '30, president of the local chapter, welcomed the initiates. A response was given by Martin Mortensen.

GOVERNOR'S EXPLANATION

"Legislative appropriations are in reality only authorizations for the governor to try to raise money," said Gov. Walter J. Kohler at the Association of Commerce banquet Dec. 12 in reference to the demand for university building funds.

"I am in sympathy with the aims of the university, and I will work for practical means of expansion," he went on.

The latest project to come under the axe of the governor's veto is the proposed mechanical engineering building. In refusing to release funds for this sorely needed addition to the facilities of the engineering school, Gov. Kohler pleaded as his reason a lack of available funds.

WARD APPOINTED RESERVE OFFICER

Dispatches from Washington, D. C., carried the news on Dec. 9 that Gerald C. Ward of Madison had accepted an appointment as second lieutenant in the engineer reserve corp. Mr. Ward, who is a former editor and at present faculty advisor for the Wisconsin Engineer, is an instructor in railway engineering in our college of engineering.

"Studies on "Experiments in Loss of Head in U, S, and Twisted S Pipe Bends", by C. I. Corp and H. T. Hartwell, and "Submerged Weirs", by Cox, have been published recently by the university press.

AERONAUTICAL SOCIETY COMPLETES ORGANIZATION

Appointments of a committee of six of the forty members of the Aeronautical society of the university to draw up a charter marked the first step toward the actual organization of a campus society for the promotion of aviation.

At the meeting Jan. 22, Edward Page '31, temporary president, briefly outlined the histories of flying clubs in other universities and submitted material procured through correspondence with the Inter-Collegiate Aeronautical association. R. P. Wagner, '32, an organizer and former secretary of the University of Alabama flying club has been active in helping form the nucleus of the local flying club.

The next meeting of the group is scheduled for Feb. 13.

Ernest Bateman, G. M. Hunt, T. R. C. Wilson, and R. M. Wirka, members of the staff of the Forest Products Laboratory, attended the national convention of the American Wood Preservers association in Seattle, Wash., Jan. 28-30.

Another member of the staff, Dr. J. D. MacLean, who has been in the west conducting wood treating demonstrations on western woods, also attended the meeting, presenting papers on the preservative treatment of Engleman spruce, and the results of heat conductivity experiments on southern pine timber.

The group inspected wood treating plants, plywood manufacturing plants, and forest products laboratory paint test fences enroute to and near Seattle.

KAPPA ETA KAPPA INITIATES

Kappa Eta Kappa, electrical engineering fraternity, held initiation Dec. 12 for Jack Tressler, '32, James Glomstad, '32, Elmer Ilker, '31, Andrew G. Woodford, '31, Eugene Kruke, '31, and John Jauch, '30.

The initiates were honored with a banquet in the Memorial Union in the evening. Speakers were Royce E. Johnson and R. R. Benedict, instructors in the electrical engineering department, E. G. Kwapil, '31, and Eugene Kruke.

BENEDICT GIVES LECTURE

"The Behavior and Structure of Dielectrics" was the subject of a talk given by R. R. Benedict, instructor in electrical engineering at a meeting of the American Institute of Electrical Engineers Jan. 15. The information presented is the result of experimental work carried on by Mr. Benedict for the past four years.

After the showing of a film of the largest automatically controlled generating plant in the world, George Steinmetz, of the Wisconsin railroad commission, told of the size and number of generating stations in the state. The 467 plants in the state generate only three or four times as much power as the one plant shown in the film according to Mr. Steinmetz.

A change in the by-laws of the association now makes it possible for anyone to become a local member at small cost, the secretary informed those present.

GLIDER CLUB BUILDS GLIDERS

A motorless airship which flies when catapulated into the air by a giant sling shot is being constructed by the University Glider club, and will probably be completed by spring vacation, according to Einar T. Hanson, grad, president of the club.

The glider will resemble a monoplane without an engine, propellor, or seats behind the wings. It will be equipped with standard airplane controls, will have a 33 foot wing span, and a five foot chord. The wings will consist of 30 ribs covered with light cloth.

Launching the glider is accomplished by the use of a rubber shock cord five-eighths of an inch in diameter, from one to two hundred feet of the cord being used. The cord is doubled and slipped into a hook at the nose of the plane, forming a "V" angle. At each of the two upper ends of the "V" three or four men, the starting crew, are placed.

The glider, which will cost about $150, is being built in the Randall shops. The entire weight will be about 170 pounds.

The Glider club was organized last fall by a group of engineering students interested in having an aviation unit in the college of engineering.

ENGINEERING SCHOOL MAINTAINS RATING

The college of engineering maintained its rating among the engineering schools of the country during the past year with a 16 per cent increase in enrollment, the establishment of a ceramic fellowship, and an addition to the hydraulic laboratory.

Total enrollment in the college is 1,090, with the greatest gain during the past year shown in the mechanical engineering course. Substantial gains were made in chemical and mining engineering courses, while civil and electrical engineering remained about constant.

A request from Dean F. E. Turneaure for an appropriation for a chair of aeronautics was refused, but Prof. L. A. Wilson is giving a course in airplane engines. A course in the mechanics of flight has been in existence for several years.

The Wisconsin engineering school now ranks 15th in size in the country.

PHI KAPPA PHI INITIATES

Prof. Edward Bennett, chairman of the department of electrical engineering, was initiated into Phi Kappa Phi, honorary activities and scholastic fraternity Jan. 16.

John Catlin ChE4, Adolph Hove EE4, Edward Heberlein CE4, Everett Johnson EE4, Ralph Kraut ME4, Robert Kubasta ME4, Franklin Matthias CE4, Rezin Plotz CE4, and James VanVleet EE4, were initiated at the same time.

Dean F. E. Turneaure, who was a member of the committee on faculty elections, presented Prof. Bennett at the banquet.

ENGINEERS ON MILITARY BALL STAFF

Ralph J. Kraut, senior in the mechanical engineering course, will lead the Military Ball Friday, April 4. Kraut was appointed chairman of the event by Major Tom Fox.

Cadet Captain Rezin Plotz, CE4, has been named as one of the assistant chairmen of the event. He will be in charge of supply.

Kraut is a Cadet Major in the military science department. As chairman of the service committee, he contributed to the 1929 military ball. He was also a member of the committee on boxes for the 1930 Prom.

After election to Phi Eta Sigma, honorary fresmmen scholastic fraternity, Kraut later received high sophomore honors. He is a member of Tau Beta Pi, Pi Tau Sigma, Scabbard and Blade, honorary military fraternity, and Theta Chi, social fraternity.

ENGLISH STANDARDS RAISED FOR CIVILS

The adoption of a more exacting policy toward students in the course in civil engineering who are "glaringly deficient" in English was announced by the Civil Engineering Committee at the meeting of the Engineering Faculty on January 27. Under the new policy, a student who is glaringly deficient in English will not be recommended for his degree. The instructor in Engineering English will be required to ascertain such deficiencies promptly so that the deficient student will have all the opportunity possible to remedy the defect before the time for graduation. The Civil Engineering Committee reserves final decision in each case that may arise under the new policy, the text of which is as follows:

Preamble

The committee recognizes that there are, from time to time, candidates for the bachelor's degree in civil engineering whose deficiencies in English are so glaring as to disgrace both the student and the college.

The committee believes that a policy in regard to such cases should be based upon (1) a desire to protect the reputation of the college, and (2) a desire to stimulate the student to gain a reasonable mastery of English composition.

Policy

The committee adopts the following policy and routine:

The instructor in Engineering English shall ascertain as promptly as possible which students are glaringly deficient in English and report them to the Civil Engineering Committee. If the committee believes that conditions justify the action, the student and his parents shall be informed, in writing, of the situation and advised that the student will not be recommended for a degree until the deficiency is removed. They shall be further informed that the means by which the student's English shall be improved is left to the decision of the student and his parents. (Home study, tutoring, and correspondence work are available for the purpose.) Ultimately the student must satisfy the Civil Engineering Committee that he has a reasonably good command of English. It is possible that in extreme cases a man who has completed all other requirements may be out of school for several years before he can satisfy the committee and receive his degree. All cases involving the holding up of degrees shall be brought before the Civil Engineering Committee for final decision just prior to the voting of degrees each semester.

Authority

The authority upon which this policy rests is found in Rules Governing Undergraduates under the heading of *English Composition,* where this statement appears:

> "Upon the completion of the required six credits of work in freshman English, a provisional pass mark is given; if at any time later in his course a student is reported deficient or careless in English composition, he may be required to take additional work in that subject."

Comment

It is believed that not more than one or two men a year will be found glaringly deficient in English. If the men who are deficient are detected in time and advised of their deficiency and its effect, they will probably make a real effort to improve themselves and most of them will probably receive their degrees at the usual time. When this policy becomes known among the students it should be a powerful incentive for them to give more attention to English during the freshman year. Although the policy would apply only to the extreme cases, it will probably tend to raise the level of English composition among all civil engineering students.

Engineering Review

Professors Kommers and Hyland Write Book on Machine Design

Reviewed by BEN G. ELLIOTT, m'13
Professor of Mechanical Engineering
University of Wisconsin Extension Division

A careful study of this new text written by two outstanding teachers of the College of Engineering of the University of Wisconsin emphasizes

J. B. Kommers

the statement made by a book publisher, "Most any one with a sufficient amount of information and knowledge can compile a book, but real textbooks come only from real teachers." "Machine Design" by Professors Hyland and Kommers is another concrete proof of this fact.

Perhaps the outstanding feature of this book is that it is written primarily for students and teachers with special emphasis on the study and teaching of the subject. This objective of the authors is found not only in the material itself but in the order and method of presentation; also in the problems and examples. The teaching of fundamental principles and considerations, as stressed in this volume, rather than of merely imparting information and facts is a hopeful indication of a pronounced trend in engineering education. Reference and data books on Machine Design are numerous; real textbooks for teaching are not.

A review of this text convinces one of the authors' deep seated conviction that Machine Design is a study not of abstractions but of concrete and material things which have a very live connection not only with mathematics and mechanics but with metallurgy, modern shop practice, the machine operator, the industrial executive, the safety engineer, and the dollar. Such could be expected from instructors who believe that a very close relationship should exist between the instruction in Machine Design and in Shop Practice.

The arrangement of the material is exceptionally good. In the first part of the text, the student is introduced to the raw materials of the designer, methods, shop practices, and materials of construction; certainly a substantial foundation. Following this comes a treatment of kinematics in such a complete and yet condensed manner as to reduce the time usually spent on this phase of the subject, another indication of a trend to conserve the student's time. After a brief review of some of the fundamentals of mechanics, the conventional machine elements are treated in a concise but complete manner. Of special interest and value is the chapter on the safety features to be given consideration in the design and construction of a machine.

The problems with each chapter are well selected and are simple in number. Answers to the problems are not given. Although the principle of including answers to problems is not

P. H. Hyland

generally accepted by engineering teachers, a set of answers to the problems in this text would perhaps increase their value to certain students, especially to those who study without the aid of a teacher. More illustrative examples would also be helpful.

As with any new book, a certain number of typographical errors, misprints, and mistakes occur. These are to be expected; but they will no doubt be eliminated in future printings.

Physically, the book is excellent; the publishers are entitled to much credit for their work.

Professors Kommers and Hyland have done an excellent piece of educational work. Engineering education needs more texts like Machine Design.

RECONSTRUCTION OF TABLE ROCK COVE EARTH DAM AFTER DANGEROUS WASH-OUT AND SLUMP

On May 4, 1928, the Table Rock Cove dam of the Greenville (S. C.) water-supply system containing about 600,000 cubic yards of earth, was nearly lost by a washout on the downstream face due to the failure of a 42-inch Class D cast-iron drainage pipe passing through it in a trench along the bank of the stream. The embankment was built across a narrow valley and it had a crest height of 140 ft. above the bed of the stream. The upward face is on a 1:3 slope up to 35 feet below the crest, and thence on a 1:2½ slope to the top. The downward face was on a uniform 1:2 slope.

Most of the embankment consists of finely divided red clay delivered to place in trains of narrow gage cars. Each layer was well compacted by road rollers. A cut off trench in the hardpan and rock bed at the site made a key for the base of the embankment. The 42-inch cast iron pipe, in 12-ft. lengths, was placed to bypass the stream during construction of the embankment. One valve was placed at the downstream end of the pipe. The upstream end was open to the pond without any regulating device.

The dam was under construction for about two years. Because of the scanty rainfall, the reservoir, with a capacity of 28,000 acre-ft., had never failed. Shortly before the accident a heavy rain raised the level of the pond to within 15 feet of the spillway crest, or 25 feet below the dam crest. Immediately previous to the washout, seepage was noticed about the valve on the pipe. This was blamed to a spring near the valve. The failure occurred suddenly in the shape of a blowout near the top of the downstream face of the dam, a short distance above the valve chamber. The rush of water left a deep, narrow trench in the embankment. The steep sides of the break remained unprotected for many months pending emptying of the reservoir and repairs. Whether the pipe was to blame or whether the water had followed along the outside of the pipe was not ascertained until later when holes and breaks were discovered in a minute study by an engineer who crawled the entire length of the pipe. The pond had to be entirely drained to permit this inspection. The upward portion of the pipe was found to be sound and undisturbed. All except eight of the 36 sections were more or less seriously damaged. The main break was found to be a triangular piece 30 inches wide and 6 ft. long, which had been completely carried away from one side of the top.

From the inspection it was found necessary to plug the upper end of the pipe, to fill cavities in and around the pipe, thus preventing seepage through or around the pipe.

The first step was the plugging of the upper end with a cast iron plug that had two holes, 6 and 4 inches in size. These holes were used to fill the remainder of the pipe with puddled clay. The lower end was plugged with concrete for a distance of sixty feet upwards. The clay was washed carefully to remove all gravel and sand and then cautiously forced, under a gravity head of 140 feet in to the 42 inch pipe. They then subjected the clay filling to a pressure of 100 lbs. of air thus insuring good packing. As soon as the cast iron plug was placed in the upstream end of the pipe the reservoir began to fill. A fill of loose rock in the deep break and coarse and fine material on top of the loose rock completed the repairs of the dam. The total amount of material placed in closing the break was 280,000 cu. yds. as compared with an estimated loss of 60,000 cu. yds. from the washout. An interesting written and pictorial account, with maps, can be found on page 934, *Engineering News-Record* of Dec. 12, 1929.

BRIDGES

Two bridges of recent completion are those located at Wilmington, North Carolina. The state highway department designed these structures and financed the undertaking by means of bonds totaling $1,250,000 which will be retired by a toll charge of 25c per vehicle.

The North East River Bridge is 2,194 ft. in length. It is composed of two deck spans, three deck truss spans, a double leaf bascule span, and steel trestle approaches. The other bridge which crossed Cape Fear is of similar construction and has a total length of 1,520 feet. It consists of steel trestle approaches, three deck spans, and a double leaf bascule span.

The large Hudson River suspension bridge at Poughkeepsie is undergoing construction with rapid progress. The end piers are completed and the footwalks are finished. On November 29, the process of cable spinning commenced. The bridge is to be finished July 1930.

An extensive bridge which will cost $2,800,000 has been authorized by the taxpayers in Vancouver, B. C. It is proposed to build a double-deck structure over the False Creek Inlet. The upper deck is to be used by vehicular traffic, the lower deck will be used for street cars and steam railways.

NEW TUNNEL IN ITALY

Ten years of work is represented by the Appenine tunnel which has recently been completed in Italy. It was commenced in 1913 but for seven years the construction was postponed because of the World War. During its construction 1300 workmen were regularly employed. 967 tons of dynamite were used to blast away the rock.

NEW AIRPORT AT CHICAGO SUBURB

The extensive growth of aviation, and the increasing need of landing fields has brought about the building of a large flying field and airport at Glenview, Illinois.

This immense project covers 480 acres northwest of Chicago and will be classed as one of the finest aviation fields in the United States. It will be used for commercial and transport flying service and as a site for a flying school. At present there are 40 student flyers at this port.

The entire area is being carefully graded, during which process 650,000 cu. yd. are being excavated. The overburden and black dirt are being removed, the clay leveled, and the dirt replaced and leveled. The drainage layout will include 80 miles of tiling. A large hangar, 584 by 128 ft., is being built on the field.

THE CIVIC OPERA BUILDING

The Chicago Civic Opera building, which is already partially occupied, is one of the outstanding structures from the standpoint of combined art and engineering interests in the middle west.

Located at Wacker Drive and Madison Street, it is one of the links of the Wacker development which is rapidly becoming a chain of building achievements along the Chicago River. The Opera building is directly across the river from the Daily News building which was completed last year. It provides convenient transportation for suburban commuters since it is within three blocks of two of Chicago's largest railroad terminals.

Besides being an ideal block for business tenants, it houses the Chicago Civic Opera and also the Chicago Civic Theatre. These two houses are probably the most outstanding examples of the modern theatre architecture and have excited considerable interest in Illinois.

(Continued on page 176)

Side Shots

Under the stress and strain of the end-of-the-semester, the best of mental machinery is apt to blow a fuse or throw a shoe and produce some rare results. Ray Reinke is awarded the non-bendable hundred-foot tape for his statement that a location survey "should proceed from a fixed and *inaccessible* point to a place of more general topography."

Al Streu, junior, has been recommended to the attention of the Mathematical Society of America for his masterly handling of an intricate equation, as follows:

$$\frac{777.7 \times 27}{27} = \frac{20998}{27} = 775 \text{ cu. yds}$$

Extreme accuracy was secured by doing the operation long hand rather than by logs or slide rule.

Harry Dever has been awarded a full-sized turnout for devising the most complicated solution of the problem of finding the distance from the theoretical to the actual point of frog. For a Number 8 frog having a half-inch point, Harry resorted to trigonometric functions and logs and found the distance to be 3.99 inches, thereby confounding those who had simply multiplied one-half inch by eight and obtained four inches as a result.

An unknown senior can secure his certificate of honorary mention by identifying the following statement made in "Water Supply." "A filter crib is an intake crib in which water is allowed to go through an *impervious* material."

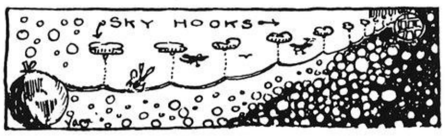
Willard Skoglund receives the James Joyce Medal for concocting the most unintelligible bit of descriptive prose produced in the course in "Curves." "Chainmen walk along chain till 50 or 25 ft. mark is reached then are lined in. When a 100 ft. have covered they drag chain by 50 and 25 ft. mark until they are lined in as normally, then drag the chain at point a chord length to next chord point."

Mr. Homewood (in Hydraulic 108): "What is a sanitary sewer?"

Sam Medler: "Ha! Can't fool me—they are all dirty."

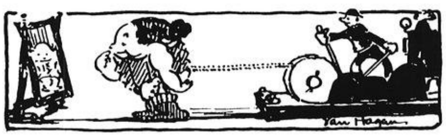
THE CIVIL ENGINEER
Second Spasm

The civil engineer I like;
My faith in him's gigantic.
Some day we'll build a noble bridge
To span the great Atlantic.



The civil engineer I like;
I know, so help me Dinah,
He'll tunnel through the earth some day,
From Hackensack to China.

The civil engineer I like;
My faith in him's unshaking.
He'll corset Nature's seismic zone
And stop Ma Earth from quaking.



The civil engineer I like;
I'm just as sure as shooting
That he could plug Vesuvius
And stop that mount from tooting.

The civil engineer I like;
I'm sure that he is able
To stretch from our old world to Mars
A trans-celestial cable.

Dumb: What did you do when you found the doorbell out of order?

Sock: Just wrung my hands.

The big difference between the stuff that the student of today drinks, and the stuff Rip Van Winkle drank is that Rip woke up.

Voice from above: "Mary!"

Voice from below: "Yes, mother?"

Voice from above: "The clock has struck twelve three times now. Let it practice one for a while."

"A certain girl calls her boy friend Paul Revere."

"Because it's a midnight call to arms?"

"No, he's always horsing around."

KENTUCKY BREAKFAST

A Kentucky breakfast consists of one tough, raw beefsteak, one quart of whiskey, and a bulldog.

And you feed the steak to the dog.

Actor: "A horse, a horse, my kingdom for a horse!"

Voice in the gallery: "Will a jackass do?"

Actor: "Sure, come right down."

NEWS ITEM

Two taxi cabs collided and eighteen Scotchmen were injured.

Taxi driver: "Where do you want to go — here your bill is already $18.75."

Slightly polluted: "Shush, back up to fifty cents—that's all I got."

Shades of great Nelson! Is nothing sacred to the engineer? He is even standardizing the language of the sailor. On page 130 of the January issue of the *Wisconsin Engineer,* in Fig. 3, we read of port and standard motors. Members of the Naval Unit are requested hereafter to shout "Hard a-standard!" instead of the age-old "Hard a-starboard!"

—*A Has-been Sailor.*

F. T. M. has met the gardener's daughter who sure knew where to plant her tuli.ps

---

Employer: "Your name, please?"

Applicant: "Quinn."

Employer: "Spell it."

Applicant: "C-o-h-e-n."

(Continued on page 188)

ENGINEERING REVIEW

(Continued from page 173)

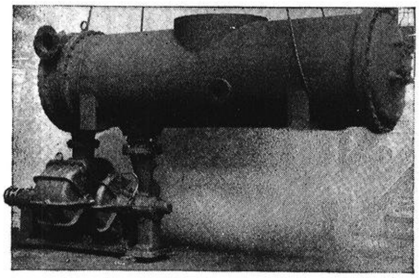
SETTING POLES BY DYNAMITE

The setting of power-line poles by dynamite is the incredible feat which has recently been accomplished by engineers.

The poles were about fifty feet long with a 16″ butt. The charge was placed in an iron pipe fitted with a removable wooden plug, and driven to the required elevation of the bottom of the pole. The pipe was then removed and the pole placed erect in a vertical position over the charge, supported by guys. A rod served to keep the charge in the ground while the pipe was being removed. At the explosion of the charge the pole dropped to the proper depth; the hole was filled about the pole and the earth tamped.

UNIT TYPE SURFACE CONDENSERS

A decided advantage to an industrial plant today, in which a power house engineering organization is not maintained, is the simplicity which manufacturers of power plant equipment have incorporated in their design. One such piece of equipment is the unit type surface condenser which meets the demand for a simple, compact and highly efficient unit in the smaller sizes of condensers. The circulating and the condensate pumps



Unit type Surface Condensor

are attached directly to, and are located underneath the shell of the condenser. The complete unit is placed beneath the prime mover which it serves; thus a minimum amount of space is required for its installation. By locating the condenser inside the prime mover foundation, the expense for foundation work is minimized and building costs are correspondently reduced.

The unit type surface condensers can be easily installed in existing plants, because they necessitate minimum alterations. Obviously, very little engineering work is required for its installation.

AIRPLANE PROVES OF GREAT VALUE IN WORK OF MAKING SOIL SURVEYS

An entire county was photographed recently from an airplane to get the preliminary data for a base map for a county soil survey, reports Dr. A. G. McCall, chief of soil investigations, Bureau of Chemistry and Soils, U. S. Department of Agriculture. The count is Jennings County, in Indiana, 400 square miles in area. This is the first time an entire county has been photographed from the air for the purpose of surveying the soil. This survey is being made by the bureau in cooperation with the Purdue University Agricultural Experiment Station.

The photographing was from a height of 13,000 feet, on a scale of 4 inches to the mile, and cost less than one cent per acre. These aerial photographs supply practically all the base-map data required for the area surveyed, and the photographs are surprisingly helpful in outlining general soil boundaries and in showing areas of soil erosion, but the chief value of

aerial photography appears to be the accuracy and speed with which the preliminary work can be done, says Dr. McCall.

Dr. McCall recently made an observation flight over parts of the Everglades, and he believes that the aerial method of observation and mapping may prove very important in initial soil-survey work in areas where conditions are not favorable for work on the ground.

ROAD COSTS CUT BY SPEEDING PRODUCTION

Modern road building is essentially a manufacturing process in which large arrays of movable plant and equipment instead of stationary factories are utilized to produce a finished product in permanent place on the right-of-way instead of in producing goods in a factory, says Thomas H. MacDonald, chief of the Bureau of Public Roads of the U. S. Department of Agriculture, in his annual report. "As in much manufacturing work," he says, "the daily cost of operating a modern road building plant is nearly independent of the rate of production."

Studies by the bureau show the daily cost of operating a modern concrete paving plant is about $400 a day whether the daily production of pavement be 500 or 1,000 feet. The most effective way to decrease unit production costs, without impairing the quality of the finished product, Mr. MacDonald believes, is to increase the rate of production. This can be done, he says, by eliminating or reducing the time losses and waste motions connected with all direct operations; in coordinating and synchronizing the rate of production of the various subsidiary operations with the key equipment; and in finding ways and means of eliminating unnecessary operations of expediting those which are really necessary.

An example of reducing time losses and synchronizing operations was a concrete pavement project during the past season in Wisconsin. The average rate of production on this project, when the bureau's engineers began their studies, was 134 square yards of pavement per hour. After the causes of the low rate of production had been located, and ways for their reduction had been pointed out and put into effect, the rate of production rose to an average of 202 square yards per hour—an increase of slightly more than 50 per cent in the rate of production with practically no increase in the daily cost of operation.

Not all projects on which work has been done present the possibility of such great improvement, Mr. MacDonald points out. But very few projects have been found on which an increase of ten per cent or more in the rate of production without impairing quality was not possible without any corresponding increase in cost of operation.

The several contractors' associations have manifested keen interest in the methods developed and the results obtained by the bureau's studies. Engineers of the States and counties are apprised of the results through published reports and papers presented at national and local engineering meetings.

We have heard of the absent-minded business man who kissed his wife and then started to dictate a letter.


A Modern Centrifugal
by Worthington
THE use of ball bearings in centrifugal pumps is a basic improvement around which Worthington has evolved other features of advanced design.
Shorter shaft span possible with ball bearings results in stiffer shaft.
Boring of bearing brackets and casing at one setting assures accurate alignment.
Close clearance of ball bearings produces smooth operation at all speeds.
These mechanical advantages, combined with improved hydraulic design, result in higher efficiency and lower maintenance cost . . . hence lower expenditure in the long run.
Bulletin W-310-B1A describes Worthington Ball Bearing Pumps in detail.
May we send you a copy?
WORTHINGTON PUMP AND MACHINERY CORPORATION
Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N. Y. Holyoke, Mass.
Executive Offices: 2 Park Avenue, New York, N. Y
GENERAL OFFICES: HARRISON, N. J.
District Sales Offices:
ATLANTA BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT EL PASO HOUSTON KANSAS CITY LOS ANGELES NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS ST. PAUL SALT LAKE CITY SAN FRANCISCO SEATTLE TULSA WASHINGTON
Branch Offices or Representatives in Principal Cities of all Foreign Countries
WORTHINGTON
WORTHINGTON
PUMPS
COMPRESSORS
Stationary and Portable
CONDENSERS
and Auxiliaries
DIESEL ENGINES
GAS ENGINES
FEEDWATER HEATERS
WATER, OIL and
GASOLINE METERS
Literature on Request

TELEPHONY BETWEEN SHIP AND SHORE

(Continued from page 163)

placement of the frequency doubler by a single-tube amplifier.

Power, controlled at a board adjacent to the transmitter, is provided by a motor-generator set supplying two thousand volts to the plate of the power-amplifier tube and fifteen volts to the filaments of all the tubes in the transmitter. A low-pass filter in the high-voltage line prevents ripples at audible frequencies from reaching the plate of the power tube. The whole motor-generator set is enclosed by panelling covered on the inner side with sound-absorbing material and on the outer with grounded copper sheet, and is kept cool by a stream of air from a blower.

Signals from the shore are received by an antenna just behind the third funnel; through circuits at the foot of the antenna and in the receiver, any signals picked up from the simultaneously operating transmitters on the ship are attenuated far below the audible level. In the first detector the received signals are combined with the output of a local oscillator to give beat-frequency signals of about three hundred kilocycles. These are amplified in three stages and then detected and the voice frequencies are passed to the line-terminal apparatus. Although no filter in the usual sense is used at any point to select the signal-frequency band sharply, the interstage circuits of the three intermediate-frequency amplifiers are tuned to make a satisfactory discrimination. To remove the effects of "fading" — the slow variations of volume to which short radio waves are subject — an automatic volume control taps the output of the third amplifier, rectifies the taken portion, and applies the resulting direct current, whose magnitude varies with the signal's volume, as grid bias in the tube of the first detector.

The voice signals after being detected and amplified by the radio receiver, or before going to the radio transmitter, pass through a control operator's position located adjacent to the radio equipment. The received signals pass through a volume control and repeater and the transmitted signals pass through a similar volume control and repeater. Volume indicators on both the transmitting and receiving sides show the control operator the amount of voice frequency volume being received and transmitted. By means of the volume controls a constant volume or level is delivered to the subscriber and the radio transmitter independent of the talker's volume. Splitting and monitoring keys are provided at the control operator's position enabling him to monitor on the circuit and talk on the radio or to the ship's subscriber as required.

From the control operator's position and equipment the circuit goes to a special radio PBX located in a room next to the subscriber's booth. This operator has splitting and monitoring facilities similar to those at the control position. The PBX operator has also a talking trunk to the control operator separate from the radio circuit and a connection to the ship's telephone system so persons on the ship who called can be quickly located.

The ship subscriber uses a standard desk telephone which has a high grade transmitter. The only other difference from the ordinary subscribers' phone is that the transmitter and receiver pairs are kept separate and shielded from each other. This is done to prevent received signals from getting into the transmitter circuit and being transmitted back to the talker as an echo.

Following the demonstration, the ship-to-shore system was made available to the public. Service will be available throughout the twenty-four hours while the ship is within range. Development work will continue, aimed at extension of the period of service, and improvement of its quality.

WIND POWER

(Continued from page 161)

fourth of the spread. The relative power generated by each is shown in the table:

Windmill	*Power*
Conventional type	75
Rotor No. 1	100
Rotor No. 2	93

The wing rotors started in a feeble wind and the direction of the wind made no difference. A rotor was also tried with its axis horizontal, but was not so successful as with the axis vertical, because the speed was lower and the mechanism more complicated. With the axis vertical this rotor gave the same Magnus effect with the same speed of rotation and same air velocity as a Flettner rotor of equal size. It could be used on ships as the Flettner rotor is used, but the Flettner rotor, being run by machine is more easily controlled. It has greater resistance to the wind than has the Flettner rotor when stationary, however, and could therefore be used to drive the ship in the direction of the wind if necessary. This increased resistance to the wind would probably be a disadvantage for its use as a windmill in case of a high wind.

The Savenius rotor with its axis vertical has certain advantages however, when used as a windmill. It has greater power over the same projected area than a windmill of conventional design. There is no vane necessary because the direction of the wind is immaterial. It is simply constructed, and the vertical shaft reduces the amount of gearing necessary. The speed of revolution can be regulated by using a flap to close the opening.

On the 265-ft. tower at Nauen, Savenius rotors will be used to drive the Flettner rotors. On the same axis with each Flettner rotor there will be a Savenius rotor, which will be made to rotate by the wind. The Savenius rotors will be 8 feet 2 inches long and have a mean diameter of 4 feet 11 inches. The Savenius rotors respond to a feeble air movement, and their velocity will be regulated by a flap to close the air passage between them.

It is impossible to tell just what the limiting size of windmills will be. A windmill 350 feet in diameter would generate 1,000 horse power. Power can be obtained from the wind in practical amounts, but the use of windmills is an economic question. The original cost of a windmill is greater than an engine, but the maintenance and operation costs are smaller. This is about the same problem that arises in the development of water power — whether the high initial cost of water power development will in the end be cheaper than the operating cost of a steam power plant.

TUNNEL ALIGNMENT WORK OF THE PENNSYLVANIA RAILROAD UNDER THE HUDSON RIVER

(Continued from page 165)

tions of the stations used in this work are shown relative to the shafts, in Figure 4; the stations A, B, C, and D were marked by permanent monuments, such as those set at the bases of the shafts. The lengths of the base lines were measured with 100-foot steel tapes, supported at the 20-foot points and pulled to a tension of 12 pounds by weights over bicycle wheels. The angles at the stations were measured with a Buff tunnel alignment transit with a circle 7 inches in diameter graduated to 10 seconds of arc. The method employed was that of repetition; that is, the angle was turned off a number of times so as to be mechanically added on the circle and thus allowing the error of a single measurement to be divided mathematically and so greatly reduced. The same work of measuring both bases and angles was done by different parties using different instruments as a check. When the bases and angles were thus measured, it was a simple matter to solve for the sides of unknown length by application of the methods of trigonometry, and thereby obtain the distance between the stations at the shafts and hence the length of the tunnels. With this knowledge, and that of the progress made at any time, the engineers could tell the exact distance yet to be tunneled.

The same type of transit as just mentioned, was used in the alignment work underground. In Figure 3 we have shown a cross-section of the tunnel and its lining. At the top is shown the position of the set-up for the transit. The observer stood upon the platform. In Figure 5 is shown in greater detail how the transit and stations were arranged. The scale is attached very rigidly to the top segment of the cast iron and concrete lining. On the scale is shown the rider with its set screws for locking it at any position on the scale, and its hook from which the plumb bob is hung. The transit platform is hung from above by heavy strap iron supports and braces. The instrument itself was screwed to an iron trivet. The entire set-up was perfectly rigid. The method of setting stations for this tunnel was peculiar to the situation. A station was not a fixed point rigidly established at the top or bottom of the tunnel as is the usual practice. Instead, a reading on the scale to which the rider was set was taken as the location. In other words, when setting the forward station when the transit is set at the preceeding station, the plumb line was brought to the proper alignment by moving the rider on the scale. In the handling of the transit while doing this, the process of double centering was followed, in order to eliminate instrumental errors. By this is meant that the backsight was taken first with the telescope direct (level tube down), and then reversed, with the telescope upside down. When there was some lack of the perpendicularity of the line of sight and the horizontal axis of the telescope, the two sights would give readings of the scale equal distances on each side of the correct central position. By simply finding the mathematical mean of the

TIME—THAT TOUGH OLD TESTER....

Meet Time, that tough old tester of everything in this world. To his aid, Time calls all the destructive forces of the universe. Years come and go, storms and sunshine, heat and cold make their accustomed rounds, while Time, the tough old tester, broods over the world, trying, testing, destroying.

Yet Time, the tough old tester, does have his troubles. Against one material devised by man, Time and his serving-men falter. That material is genuine Puddled Wrought Iron—the metal of which Reading 5-Point Pipe is made. Watch for the next coming of Time, the tough old tester—you can learn about pipe from him.

READING IRON COMPANY, Reading, Pennsylvania

For Your Protection, This Indented Spiral Forever Marks *All*

5 POINT PIPE
READING
GENUINE PUDDLED WROUGHT IRON
DEFIES VIBRATION · RESISTS CORROSION · HOLDS COATINGS · THREADS EASILY · WELDS BETTER

GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM 1/8 TO 20 INCHES

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Wrought Iron readings, the position of the proper line was determined, and the rider set at that reading.

During the progress of the work, a very satisfactory way of illuminating the station sighted upon, was developed. Eight 32-candle-power incandescent bulbs were mounted in a box the front of which was made of oiled paper. The back of the box was opaque. This box was held behind the plumb bob and string and made it easy to bring the vertical wire of the transit into perfect coincidence with the string.

One of the features that distinguished this job of tunnel surveying was the movable character of the lining of the tubes. As has been mentioned before, a large proportion of the material through which the tubes were driven was of a soft or unstable character. In fact between certain points concrete piles were necessary, in order to avoid extreme settlement. But in spite of the pains exercised in preventing it, some settlement and shifting down stream did take place. The amount of this movement was detected and determined by the tunnel survey. It was found that when repititions of the prolongation of the lines, starting back at the shafts where conditions were stable, the stations set on line did not fall at the same points on the station scales. Therefore it was necessary to run lines periodically, and by recording the amounts by which the results of one survey did not coincide with the initial, it was easy to keep a record of the movements of the tunnel lining. It is obvious that due to these movements, it was necessary at times to change the direction of driving the shields in order to correct for their being at places out of line. The repetitions of the alignment were made about every three weeks.

In the details mentioned, and in all operations and equipment employed in the directing of this piece of tunnel work, every refinement was adopted. The survey control was an integral part of the work, and was responsible in large measure for the entire success of the project.

NEW PROCESS OF MAKING RUBBER ARTICLES

Rubber articles can now be made by a process similar to that by which nickel plating is done. Electric current is passed through a mixture of rubber latex with water, sulphur, fillers, accelerators and other materials according to the requirements of the article to be produced. A coating 1400 times as thick as nickel plating can be deposited with the same amount of electric current.

It makes no difference how smart you are, the old cow won't back up to you while you are sitting in the shade to be milked.—*Topeka Daily Capital.*

A YOUTHFUL STATISTICIAN

Old Lady: "Little boy, I'll give you a penny if you'll go on an errand."

Son of College Professor: "I'm sorry, madam, but do you realize that every hour lost from study costs me fourteen dollars and thirty-seven cents?"

—*Pennsylvania Punch Bowl.*

"BANK AT THE BRANCH"

TWO DIMENSION PAPER

(Continued from page 159)

This new paper is going to ruin the waste paper basket industry. The paper, being so light compared to the tremendous weight of ink and graphite on it, will fall with the used side down. This will leave the invisible imaginary side up, and no waste baskets will be required for storage of used paper.

Heretofore attempts have been made to use paper for clothing, but the stuff was too bulky, and worst of all it scratched. If this new paper is used, and the imaginary side is put in, it will not scratch, unless one's imagination is very wrong. If the wrong side is put out, no imagination will be required.

Electricals and other small boys addicted to paper wad throwing will find it safer to use this one sided paper, and put the invisible side out. Even the teachers bright enough to look where the missiles come from instead of where they hear them land will be up the famous creek against invisible spit wads.

Several interesting devices will be used in the mill manufacturing this one sided paper. We intend to use some of the famous Larson b. t. u. strainers in our stacks. This will increase overall plant efficiency quite a bit, because strainers allow only a few of the smallest b. t. u.'s through. Of course we will use turbines for prime movers. John Mueller has developed an indicator for obtaining turbine cards.

SIDE SHOTS

(Continued from page 174)

An'en sez he: "The three brass balls in front of a pawn shop mean two-to-one that you don't get it back."

Prof.: "Freshman, why don't you take notes in my class?"

Rat: "My father took this course, and I have his notes."

"What a unique town."

"Unique?"

"Yes, taken from the Latin, unus meaning one, equus meaning horse — one horse."

"So you had a scrap with your wife last night?"

"Yes, quite a laughable affair."

"Laughable?"

"Yes, I thought I'd split when my wife took after me with the axe."

"This is the last time I'll get stewed," said the co-ed as the cannibal chief put her into the kettle.

Maid: "The lady can't see you just now, she's in her bath."

Agent: "Oh! thta's all right, you see, I sell soap."

"Spring is here," yelled the drunken Indian as he jumped up and down on the bed.

Judge: "I fine you a dollar and ten cents for beating your wife."

Prisoner: "What's the ten cents for."

Judge: "Federal tax on amusements."

"What would you do if a horse fell into the bath tub?"

"Just pull out the plug."

He took her about her delicate little waist and lifted her lightly into his arms. Her eyes closed, a wisp of golden hair caressed his forehead. His breath was fanning in her waxen cheek. Suddenly, he set her down almost harshly.

"Gee," he said, "it sure is hell to work in the doll department."

—*Michigan Technic.*

The train is much safer than the automobile. Yes, the engineer has only the fireman in the cab with him — and thus is able to drive with both hands.

An Appraiser sent to a certain home to make an appraisal of the contents. His record shows:

One full bottle of Scotch Whiskey.

One bottle of Scotch Whiskey partly full.

One revolving Persian rug.

"A pretty snappy suit," said the baby as he was put into his rubber panties.

Lady (to tough old Tar): How do you keep from getting seasick?

T. O. T.: Bolt my food, Madam.

Uriah, why dost thou whitewash the chicken coops?

Fie, Oswald, to keep the chickens from eating the grain in the wood.

POME

A hundred years ago today,
A wilderness was here.
A man with powder in his gun,
Went forth to hunt a deer.

But now the times have changed,
Somewhat along a different plan;
A dear with powder on her nose
Goes forth to hunt a man.

ALUMNI NOTES

(Continued from page 169)

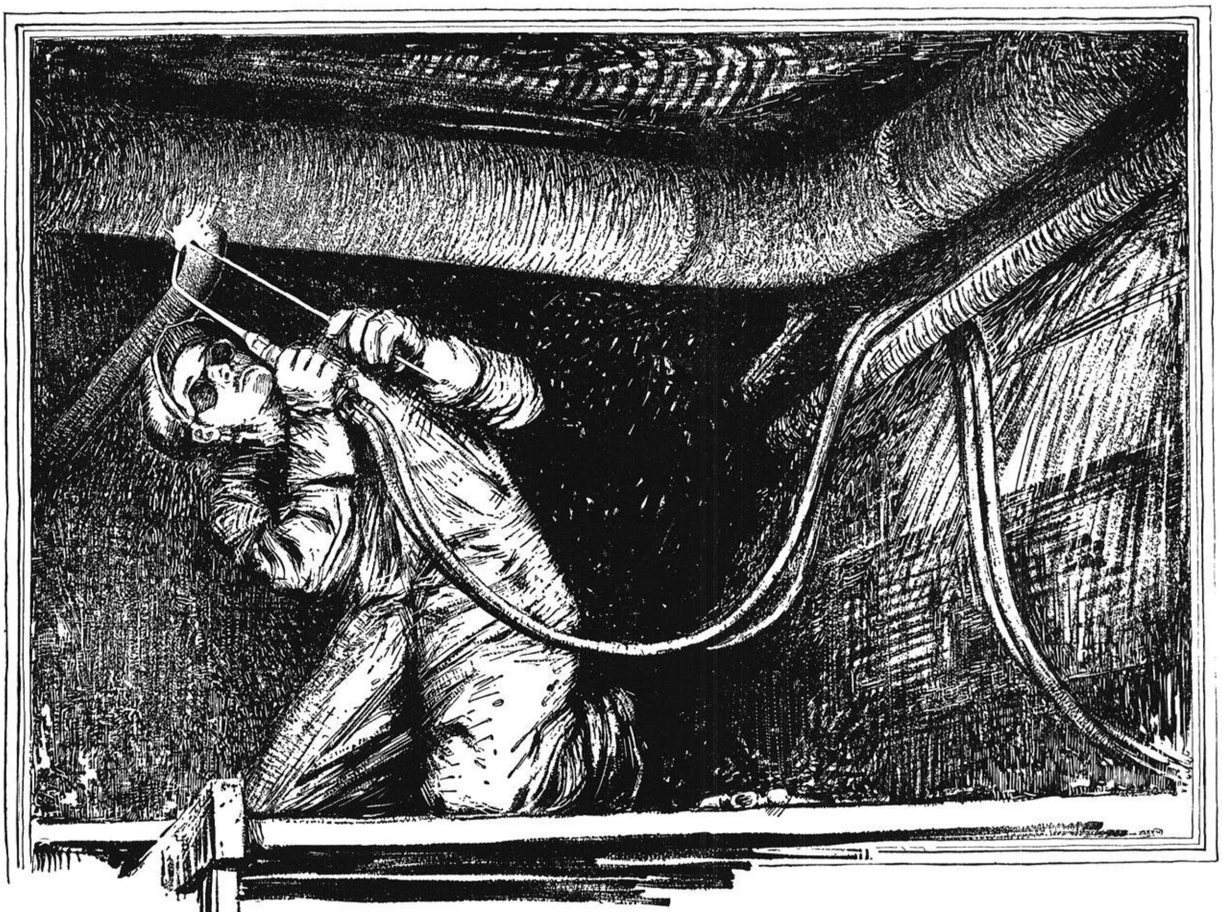
Rateike, George W., e'24, is with the Metropolitan Motor Coach Company of 1230 Edison Building, Chicago. Address: 16 S. Maple Avenue, Mt. Prospect, Illinois.

Reese, Allen H., e'26, is living at 415 Wilson Street, Madison, Wisconsin.

Rothermel, Ulla A., e'27, is with the Northern Indiana Service Corporation at Fort Wayne, Ind.

Sarri, Toivo H., is living at 126-18th Street, Milwaukee.

Schuchardt, R. F., 'e97, EE'11, engineer for the Commonwealth Edison Company of Chicago, delivered a presidential address before the A. I. E. E. at Swampscott, Mass., last June that appears in the Transactions of the society for October, 1929. Taking as his subject, "The Engineer, Practical Idealist", and as his text Glenn Frank's analysis of the machine age and its trends, "the masses have more to hope for from great engineers, great inventors, and great captains of industry than from social reformers who woo them with their panaceas," Mr. Schuchardt reviewed our present civilization, defended the value of the material comfort it offers, and pointed out the problems whose solution depends upon the engineer. "The engineer," he said, "has brought countries together by rapid transportation, by land, by sea, and by air, and has tied them still closer by achievements in communication, and now even by international power lines. What can he do to hold them together as friendly neighbors? . . . Is it too idealistic to expect improvement in our day to come as a result on more engineering in government; that is, more of the engineering method applied to the solution of questions that tend to bring discord between peoples and between people? . . . Our country, appreciating the keen need of the time for the engineering approach to the important



problems of state, has elected an outstanding engineer to the presidency. In other countries the engineer must similarly stand at or near the helm if this civilization is to survive."

Scorgie, Robert, e'27, is with the Wisconsin Telephone Company at Milwaukee.

Steel, Beaumont, e'24. Address: 250 Pearl Street, Grand Rapids, Michigan.

Streeter, P. Raymond, e'25. Address: 129-13th Street, Milwaukee, Wis.

Wolfe, Harry C., e'26, former editor of the Wisconsin Engineer, is vice-president and manager of the United States Chromium Corporation at Wilkinsburg, Pa.

Wooldridge, Kent E., e'25, M. S.'26, is with the Chicago Rapid Transit Company at 72 West Adams Street, Chicago. Address: 3444 Janssen Avenue, Chicago.

Young, Orris S., e'27, is with the Western Electric Company of Chicago. Address: 238 North Pine Avenue, Apt. 103, Chicago.

Dewire, Donald S., e'22, is with the New York Telephone Co. at Albany, N. Y.

Hantzsch, Ralph E., e'21, is chief engineer for the Best Mfg. Co. at Irvington, N. J.

Gower, Arthur W., e'17, is captain with the 52nd Coast Artillery at Fort Eustis, Va.

Bohn, Donald E., e'21, is with the Aluminum Company of America at Pittsburgh.

Wolfe, Harry C., e'26, former editor of the Wisconsin Engineer, is vice-president and manager of the U. S. Chromium Corporation. Address: 121 Carnegie Place, Pittsburgh, Pa.

Steel, Beaumont, e'25, was married on Nov. 28 to Marion Stevenson of Milwaukee.

McCann, William R., e'15. Address: c/o Atmospheric Nitrogen Corporation, Hopewell, Virginia.

Thomas, C. W,. e'25, is assistant system operator with the Public Service Company of Northern Illinois. Address: Box 313, Niles Center, Illinois.

Andrae, S. C., e'25, is employed in the electrical engineering department of the Consolidated Steel Corporation in Los Angeles. Address: 3060 E. Fifth Street, Los Angeles.

Davis, Robert J., e'27. Address: Room 508, 26 Broadway, New York City.

Potts, J. Arlington, e'23, has a daughter, Elizabeth Roberta, born on Oct. 1 at Milwaukee.

Brooks, Ralph R., e'26, is in the railway control department of the Westinghouse Electric Company, whtre he has been working on the design of the "VA" type control for street cars, and the application of dynamic breaking to light trolley service.

MECHANICALS

Foster, Dean E., m'06, writes thus: It is a wise son that knoweth his own father,—or it is a wise father that showeth his true personality to his sons; or it is a lucky paper that can publish the low-down on its alumni as revealed through their sons. Said John Foster (aged nine): "Is daddy a civil engineer?" Said Walter (aged twelve): "No he is a mechanical, Wisconsin '06." John: "Then he is not civil?" Walter: "I'll say he is not civil!" Address: 1001 South College, Tulsa, Okla.

Wadt, Charles G., m'84, ME'89, died recently at his home in Wauwatosa following a heart attack.

Maurer, C. N. (Bubbles), m'16, until recently traffic engineer for the Wisconsin Highway Commission, is sales promotion engineer for the Heil Co. of Milwaukee.

Campbell, Claude W., m'22, is factory manager for the Automatic Washer Co. of Newton, Iowa.

Edwards, Bruct V., m'09, is with the Industrial Development & Securities Corp., at Sewaren, N. J. Address: 221 Ridgewood Road, South Orange, N. J.