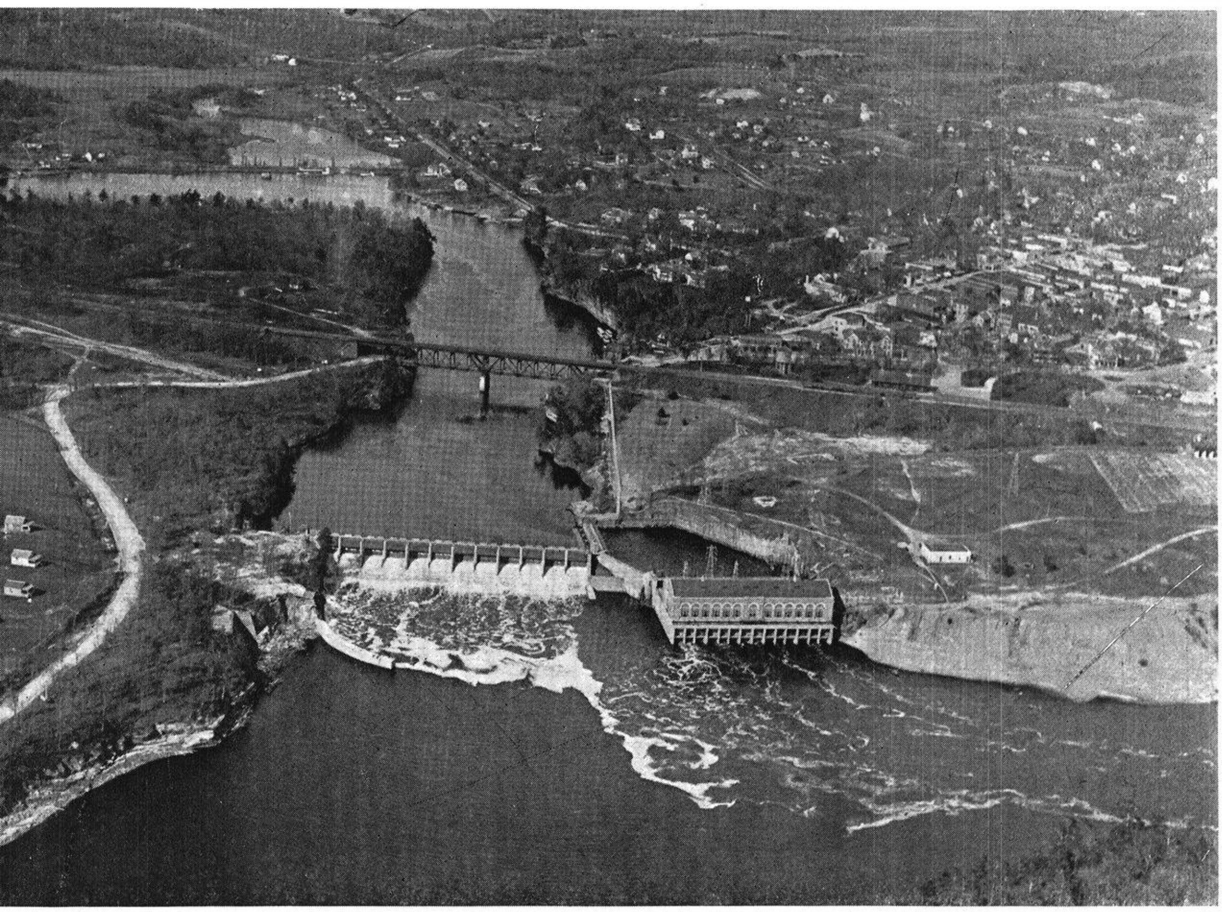
The Wisconsin engineer. Volume 36, No. 3 December 1931

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

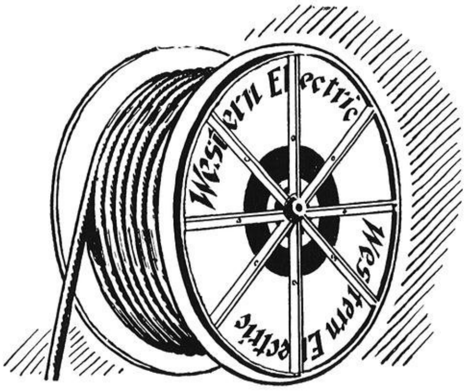
https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

THE WISCONSIN ENGINEER

MEMBER
E.C.M.A.



DECEMBER
1931



Insulated
. . . but not against new ideas!

High quality wood pulp now used to form a sleeve around the wire

Even the method of insulation is not insulated against improvement at the Western Electric telephone cable shop. For a generation wires have been wrapped around with a narrow ribbon of paper but now the wire has the paper made right on it while passing through an ingenious paper making machine. . . . This new revolutionary process saves time and lowers the cost of cable. But perhaps the most important thing about it is that it illustrates an attitude of mind of your Bell telephone makers: keeping receptive to innovation. . . . Only by doing so, they realize, can they carry out properly their functions as manufacturers, purchasers and distributors for the Bell System.

Three steps now in one — paper making, slitting and insulating

Always searching for new ideas

Western Electric

Manufacturers . . . Purchasers . . . Distributors

SINCE 1882 FOR THE BELL SYSTEM


EVERYTHING FOR OXWELDING AND CUTTING
LINDE OXYGEN
Prest-O-Lite
DISSOLVED ACETYLENE
Oxweld
APPARATUS AND SUPPLIES
UNION CARBIDE
UCC

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 177W - 277

CONTENTS

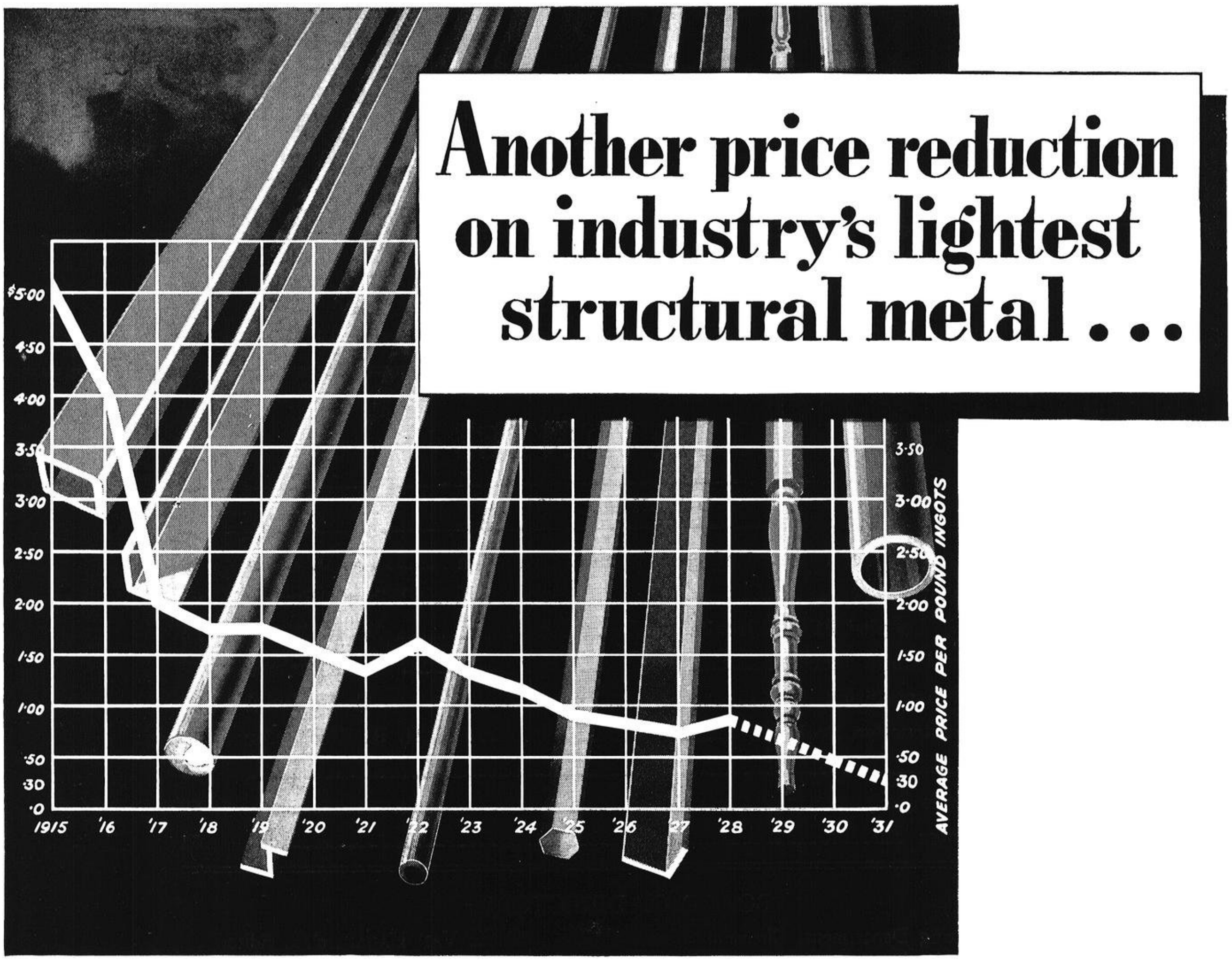
VOLUME 36 DECEMBER, 1931 NO. 3

Member of Engineering College Magazines, Associated

MR. WILLARD V. MERRIHUE, *Chairman*, 1 River Road, Schenectady, New York

Auburn Engineer
Armour Engineer
Colorado Engineer
Cornell Civil Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Nebraska Blue Print
Ohio State Engineer
Oregon State Technical Record
Penn State Engineer
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Sibley Journal of Engineering
Tech Engineering News
Tennessee Engineer
Wisconsin Engineer

LITTELL-MURRAY-BARNHILL, INC., *Sales Representative*, 40 East 34th St., New York; 400 No. Michigan Ave., Chicago; 1400 Massachusetts Ave., Cambridge, Mass.



NOW YOU CAN MAKE IT WITH DOWMETAL

FROM a rare metal at five dollars a pound to a plentiful commercial metal at thirty cents is the achievement which has put Magnesium and its alloys into the manufacturers' hands to work wonders with manufactured products.

Magnesium, one of the most plentiful of all metals in the earth's crust, is also the lightest of all structural metals— 1/3 lighter even than aluminum and only 1/4 the weight of iron. Now with our latest price reduction, it may be had in carload lots at 30 cents and in less than carloads at 32 cents per pound.

The availability of Dowmetal in fabricated forms as illustrated, having only 1/4 the weight of steel, will at current prices suggest their use to improve products and give them increased sales value by eliminating dead weight. Dowmetal can be furnished in commercial quantities in all the common structural forms, such as sheet, bars, rods, angles, channels and tees, as well as castings and forgings.

Gain the advantage of being the one to replace heavy, hard to handle products with light, strong, enduring and attractive improvements. Dowmetal may be cast, rolled, drawn, forged, extruded and welded by methods common in industry. It is readily fabricated and is the easiest of all metals to machine. Write for further information.

Dowmetal Division
THE DOW CHEMICAL COMPANY
Midland, Michigan

DOWMETAL
MAGNESIUM ALLOYS

Take useless dead weight out of your products.

The WISCONSIN ENGINEER

VOLUME 36, NO. 3 DECEMBER, 1931

A Graduate Describes From Experience

The Chicago Open-Well Method of Foundation Construction

By J. D. Levin, c'27

THE Chicago open-well type of foundation construction, more commonly known as the Chicago caisson, was developed to solve the foundation problems which accompanied the introduction of heavy buildings in Chicago about forty years ago.

Typical Chicago soil conditions comprise a deep surface layer of soft blue clay, changing with increasing depth to a more dense, hard dry clay, sometimes called hardpan, and quite frequently passing through sand and gravel pockets before reaching the hard limestone bedrock underlying the Chicago area. These great limestone strata occur at varying depths in this vicinity, from 125 feet below the surface in the Loop district, to surface outcroppings in the west side. It was largely because someone discovered that the Chicago blue clay formation was of such consistency that vertical walls of six feet and more would stand for a considerable time without crumbling, that the open-well method was brought into existence. In general this type of foundation has proved to be most economical and expedient under soil conditions similar to those in the Chicago district.

The construction of the Chicago open-well involves four distinct operations: (1) excavating the well, (2) removing the spoil, (3) setting and bracing the lagging, and (4) concreting the well to proper elevation. Special operations may be necessary, such as flaring or belling the well (increasing its diameter), and the driving of steel sheet piling when water-bearing gravel is encountered below the surface, or the blasting of huge boulders far below the surface when they cannot be broken by ordinary means, but since these occurrences are the exception rather than the rule, they will not be described in this article.

The field engineer, or whoever is responsible for lines and grades on the job, sets the center stakes for the wells and furnishes to the caisson diggers a stick the length of which is equal to the radius of the well plus the thickness of the lagging or sheeting. To well diggers this is known as a "sweepstick" and is used in conjunction with the engineer's stake as a center to mark the periphery of the well. For example, if a 6-ft. caisson is to be laid out and 2-in. lagging used, the length of the sweep is made 3 feet 2 inches, and the corresponding circle will be 6 feet 4 inches in diameter, allowing 6 feet for the caisson and 4 inches for the sheeting. A circular hole is excavated the depth of the lagging to be used, the sheeting is set upright against the trimmed sides of the hole, and two steel rings are placed horizontally against the inside of the sheeting. The field procedure usually consists of setting only four or five pieces of lagging against the sides of the excavated area, placing the lower ring in position about 15 inches from the bottom, then setting the remainder of the lagging, and finally setting the upper ring about 15 inches down from the top of the lagging. It may be explained here that lagging or sheeting is ordinarily 2x6-in. tongue-and-groove maple stock, dressed on both sides, and may be had in lengths from 4 to 6 feet, the standard length being 5 feet 4 inches. For large wells the sheeting may be $2\frac{1}{2}$-in. or 3-in. stock. Each set or section of lagging is braced with two $3\text{x}\frac{3}{4}$-in. steel rings, each consisting of two semi-circular sections bent radially to form lugs which are butted against the corresponding lugs of opposite halves. Machine bolts, of $\frac{5}{8}$-in. diameter, are used to fasten the lugs together and to hold the rings in alignment.

The first set of lagging is carefully centered and set in place, for it is used as the basis of centering and plumbing all the lagging below. When the excavation has been carried down an additional 5 feet 4 inches, another set of sheeting or lagging is installed directly below the first set, and the corresponding set of steel rings is bolted in place. This operation is continued until the required depth is reached.

Excavation of the soft blue clay is done by hand, employing a special type of shovel which is a cross between the ordinary square-edged shovel and a spade. When stiff dry clay or hardpan is reached, compressed-air spades are utilized to expedite the work. The loosened material is loaded into circular steel caisson buckets, holding about 4 cubic feet when filled, which are hoisted to the top of the well by an electric winch or niggerhead. Formerly hand-operated winches were used for this purpose, but present-day practice favors the use of electrically-operated niggerhead units which are rented to contractors by the patentees. Each well is equipped with a wooden platform upon which is placed a timber tripod or head-frame, covered with canvas for the protection of the working crew. Resting on two planks bolted to the tripod timbers, about 3 feet above the platform, is the niggerhead unit which is coupled through a speed reducer to a 5 h. p. electric motor. When the spoil reaches the top of the well, it is dumped on the platform and then loaded into wheelbarrows, which may then be unloaded directly into trucks from a loading platform or hauled to a tower and dumped into buckets at general excavation level; these buckets are then hoisted to field hoppers discharging into trucks at sidewalk level.

A typical crew on this type of construction consists of from 1 to 3 diggers, 1 niggerhead tender, 1 dumper at the top of the well, and from 1 to 3 wheelers. It is common practice to have 1 digger in wells less than 5 feet 6 inches in diameter, 2 diggers in wells from 5 feet 6 inches to 6 feet in diameter, and 3 diggers in wells greater than 6 feet in diameter. Under ordinary conditions, as many wheelers will be required as there are diggers.

It is customary practice in caisson construction to arrange the work so that a number of wells are progressing at various stages at any one time. Since speed is the essence of the building projects where Chicago open-wells are specified, three 8- hour shifts are frequently employed on such work.

On the Chicago Daily News job, involving the digging of 160 caissons in the fall of 1928, varying from 4 feet to 9 feet 9 inches in diameter, work was so arranged that from 20 to 35 wells were progressing at one time. The average caisson on this job was about 100 feet in depth, of which 1/3 was soft blue clay dug by hand, 1/3 was stiff clay and hardpan excavated with compressed-air spades, and the remaining 1/3 was water-bearing sand and gravel which had to be sheeted with steel piling before work could proceed.

During the summer of 1928 the writer was engineer on the construction of 84 Chicago wells built to carry a 12-story reinforced concrete cold storage building in Chicago. Nine wells were driven at a time, and three 8-hour shifts of workers were kept busy until the wells were all excavated. Experienced well-diggers were employed under the supervision of a caisson foreman who was familiar with conditions in this district. No water was encountered during the entire job, and consequently no flaring of wells was necessary. Medium-size boulders were encountered in six wells but these were handled by ordinary methods. When the clay became too stiff and hard to dig economically by hand, compressed-air spades were introduced. Thomas Elevator electric niggerhead units were used to hoist the spoil. Rock was reached at an average depth of 39 feet below Chicago datum, or about 50 feet below street level. Half of this depth was soft blue clay, while the remainder consisted of stiff clay with an occasional pocket of sandy clay.

With a typical crew, as outlined in an earlier paragraph, and not including the foreman's time, and time making, erecting, and stripping runways, platforms, and tripods, the average labor involved on this job was as follows:

Digging, lagging, and setting rings	2¼ hr./cu. yd.
Hoisting spoil to top of well	1¼ hr./cu. yd.
Dumping and wheeling to trucks	2½ hr./cu. yd.

From these figures it can be readily seen that under the conditions noted, the number of wheelers required paralleled the number of diggers. Based on time records covering approximately 3,000 cubic yards of caisson excavation, this average summary shows that about 6 man-hours per cubic yard are required to dig, lag, hoist, dump, and wheel to truck.

Another Chicago caisson job, with similar working crews, but under somewhat different conditions, reported the following progress per 8-hour shift:

Blue surface clay	12-15 ft./shift.
Hard clay and hardpan	3-6 ft./shift.
Water-bearing sand	2 ft./shift.

Concreting these Chicago caissons is ordinarily not beset with any particular difficulties. Concrete is mixed at a central plant, and wheeled to the hole with concrete buggies or, in special instances, with Clark Tructractors. The caisson rings are usually withdrawn as the concrete is dumped into the well, unless the architect has specified otherwise. The usual mix for caissons is the old standby—1:2:4, that is, one part of cement, two parts of sand, and four parts of coarse aggregate, measured by volume. Where heavy column loads occur, structural designers have found that it is frequently more economical to specify richer mixes, for example, a 1:1:2 mix, than to design wells of larger diameter. The upper four feet or so of the caisson is commonly reinforced with short spirals and vertical rods.

THE DECEMBER COVER

Editor's Review

The famous Kilbourn plant of the Wisconsin Power and Light Company is the subject of the December cover. The plant, which is one of Danny Mead's favorite illustrations of whatever he has to illustrate to his classes in hydrology and water power, has for a long time supplied electric power to the southeastern part of the state and until the completion of the Lakeside plant at Milwaukee, supplied the power to that city. The oft-mentioned head-race hewn from solid rock, and the deflecting wall in the white water below the dam which prevents scour on the opposite bank are here presented to the student in visual form. Those who have taken Professor Mead's courses will long remember this plant as being almost equally dear to him as was the time he spent as city engineer at Rockford.

Behind the power house can be seen the C. M. St. P. & P. bridge which carries the main line across the river on the top deck and carries the state trunk highway across on the lower deck.

The Removal of Sediment from

Magnetically Coupled Filter Circuits

in Water Supply Systems

By W. R. Winch, e'32

The reader is cautioned not to enter this article with too much credulity, since it is the result of initiation demands on one of the electricals who sought membership into the bond. The removal of sediment from the water supply is a problem over which the civils ponder to considerable extent in their course in water supply, and it is for their benefit and elucidation that this novel and original solution is presented. — Editor.

THE problem of devising an economical and adequate method for removing the sediment from magnetically coupled filter circuits has challenged the attention of engineers for some time. The laborious process of removing the sediment by hand which has hitherto been the chief objection to this type of filter circuit, has stood in the way of its general adoption by engineers in charge of water supply systems. This problem has been attacked from a mathematical basis, and it has been revealed that the removal of sediment is an exceedingly simple operation. It is hoped that as a result of this investigation the magnetically coupled filter circuit will meet with more favor in the future.

First, it should be explained what is meant by a magnetically coupled filter circuit. This is made up of 14 (200 mesh) screen grids three inches square. The 14 pieces of 200 mesh screen grids are placed one on top of the other in a pile with mica between. Every alternate screen is connected to another conductor on the other side, forming a condenser. This screen grid is enclosed in an air tight box that is open on both ends. This forms the magnetically coupled filter circuit.

The function of this filter is to remove the sediment from the water system. It is well known that all of the sediment in a given supply tank is vibrating at a definite frequency. For the previously described filter to function, it is necessary for the frequency of the sediment to be known.

After considerable work the formula for the determination of the wave length was derived: $\lambda = h/mv$, where λ is the frequency, m is the weight of the sediment or mud in pounds, and v the viscosity of sediment in light-years, h is a universal constant, $6.547 \pm .008 \times 10^{-27}$ erg-secs. This formula requires that the sediment be analysed before it can be used.

Now when we have the wave length or frequency, we are ready to use the magnetically coupled filter circuit. In order for the circuit to remove the sediment there must be an electrostatic charge placed on the screen grids of the filter. The amount of charge to be placed on the filter, is a function of the frequency of the sediment. The determination of the charge as a function of the frequency is made by the use of Lorentz-Einstein Transformation. This involves the solution of a third order differential equation.

$$(\lambda q)^5 \; d\lambda 3/dx^3 + (q/\lambda) \; dq2/dx^2 + dqy/dx = 10$$

The solution only of this equation will be given as it will take too long to work it out in full.

$$10\lambda q + z \; (936.4432)k = \text{zero}$$

where q is the charge, λ is the frequency, z is the number of phases, and k is just a constant of intergration that can be dropped with only a small per cent of error.

Now it is easily seen from the equation that the constants are all mixed up in the formula. To remove this trouble both sides of the equation were divided through by Pi which is the standard way of making things balance up and come out even.

Now with the charge determined for a given frequency, we are ready to remove the sediment. This is done by submerging the filter to exactly half of the depth of the water in the tank, making sure that the water makes good contact with the screen grids or the filter will not function. Then the screen grids of the filter are charged to the previously determined charge q. Due to the very good insulating property of water, there is no trouble in charging the grids up to any potential with a static machine.

The function of the filter is this: it removes the frequency of the sediment from the formula $\lambda = h/mv$. This leaves the expression h/mv without any equivalent, which is mathematically impossible and the expression can not stand, so it must settle out of the water. In as much as this part of the expression contains all of the sediment, the sediment is removed from the water in the tank.

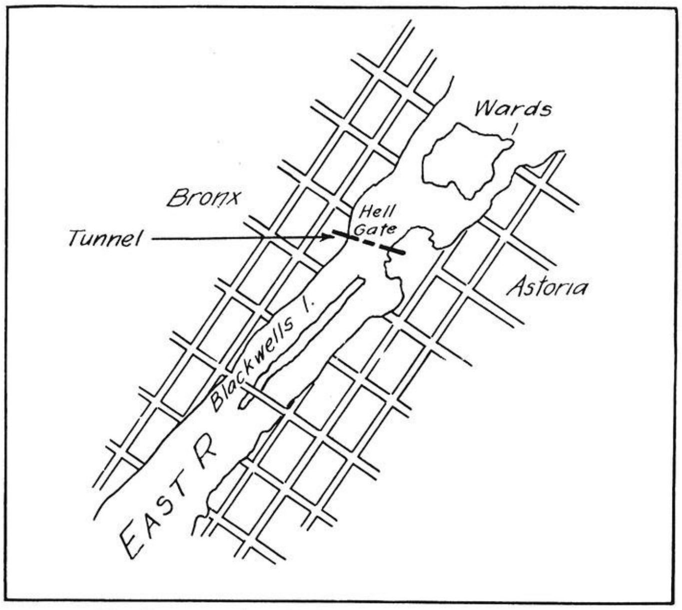
By this method the sediment is not allowed to gather in the magnetically coupled filter circuit so the problem of the removal of the sediment is eliminated.

Driving the Astoria Tunnel

An Engineering Romance

By W. J. Parsons, Jr., c'26

THE driving of the Astoria Gas Tunnel under the channel of Hell Gate was one of the most difficult pieces of tunnel excavation within the last twenty years. The extreme depth of the tunneling, required to get below the deep channel with sufficient cover, carried the work far below the range of pneumatic construction. The tunnel was driven under full atmospheric pressure through shattered, rotten rock filled with water. The rock was crisscrossed with crevices communicating with the river overhead and admitting water under a pressure of 90 lb./sq. in. to the workings. After three years, the tunnel was holed through, after surmounting almost impassable obstacles. Before the rest of the tunnel could be finished and the lining placed, the tunnel was flooded and all the work, except one shaft and a short stretch of tunnel, lost. The water in the flooded workings rose and fell with the tides, indicating connections with the river sufficient to make any effort to pump the tunnel dry, equivalent to pumping out the whole North Atlantic Ocean. Yet the tunnel was recovered and placed in operation January 10, 1915, a year and a half after the loss of the tunnel, and four years and a half after ground had been first broken.



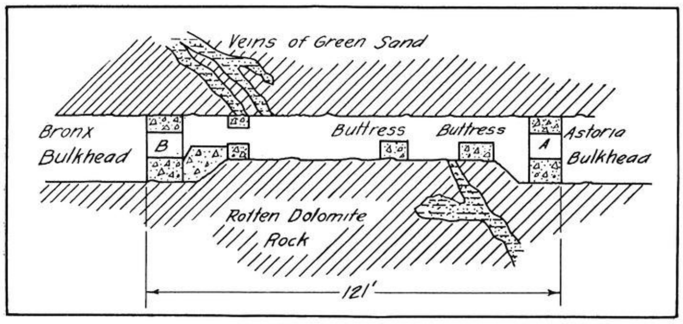
Sketch Map of Hell Gate and Environs Showing Location of Tunnel.

Originally, the Consolidated Gas Company of New York City supplied the boroughs through a series of small plants scattered through the city, mostly on the water front where water transportation could reach them. As the years went on, the company was forced to abandon these plants under the economic pressure of increasing ground rents and to make way for the waterfront improvements of the city. The company decided to redesign their system and construct one large group of plants to supply the whole city. The little plants were to be replaced with small booster stations. This large group of plants was to be built at Astoria, on the south shore of the Hell Gate. The land was cheap and beyond the expansion of the city for many years to come. Water transportation was at hand. The Long Island boroughs could be supplied by large mains radiating from the Astoria plant. Lower Manhattan was fed from the Brooklyn system through the old East River Gas Tunnel, that had been driven in 1894. The northern boroughs would be supplied through a new gas tunnel under Hell Gate. It is in the construction of this tunnel that we are interested.

The risers are carried to the tunnel through two vertical land shafts 270 and 230 feet in depth. The tunnel connecting the bottoms of the shafts is 4662 feet in length, rising on a grade of 0.5% from the Astoria shaft, in order to drain the seepage water of the tunnel into the sump under the Astoria plant. The section of the tunnel is D-shaped with a vertical height of 21 feet and a horizontal width of 20 ft. Four 72-inch mains will eventually be placed, two of these to be installed at the completion of the tunnel.

The channel of the Hell Gate is 4000 feet wide at this point with a maximum depth of 90 feet below mean sea level. The currents in the channel are excessive, a tide rip occuring twice a day. It will be impossible to blanket the bed of the channel in case of accident, and no work can be done from the surface, all tunneling being done from the land shafts. The rock on both shores is Fordham gneiss, a hard, intensely metamorphosed rock, difficult to tunnel. The channels mark the contact of this gneiss with a hard Inwood dolomite. The two channels in Hell Gate mark the two contacts with this rock and show a weakened condition of the rock. From experience in driving other tunnels, it has been found that at the Bronx contact the rock has broken down into a fissured, decomposed mass of rotten rock. The gneiss was badly fissured and decomposed into incoherent masses of green sand. The dolomite was reduced to rotten-rock and penetrated with dikes and pockets of igneous material. The centerline of the tunnel crosses the contact at an angle, so that the bad material first appears at the roof of the tunnel and disappears at the invert 300 feet beyond. It is impossible to avoid the contact.

Work was started at both shafts in September, 1910, and good progress made. The rock was fairly dry and rapid progress resulted. By April, 1911, both shafts were turned and the tunnel proper begun. The rock was still solid and dry. A record in tunnel excavation was made when the Astoria heading was driven 17 feet in a working day, displacing 100 cu. yds. of material. The heading was first driven, a second gang cutting down the bench, and a third gang placing the lining.



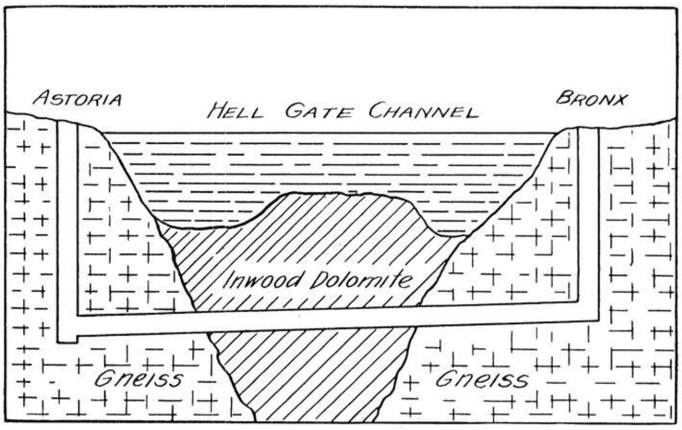
Detail of Section in Which the Trouble Occurred.

Trouble was first encountered on the Bronx heading as it approached the expected contact between the gneiss and the dolomite. First came veins of decomposed dolomite enclosed in the mass of the gneiss. Water started to enter the tunnel under low pressure, seeping in through the veins and rotten rock. The pumping plants at the shafts easily handled the flow of water, being designed to lift 1000 gal./min. at the Bronx end and 1400 gal./min. at the Astoria end. A month later, the first high pressure water was encountered. A test hole, driven ahead of the heading to explore the rock, pierced an open crevice and delivered water into the tunnel under 90 lb. pressure. Other test holes were driven, and grout forced into them under 125 lb. pressure, to seal the crevice. The grouting was unsuccessful. On August 29, 1911, the entire side of the heading caved in, releasing a flood of green sand and water at the rate of 1000 gal./min. It was estimated that 1000 cu. yds. of sand were carried into the tunnel before the flow could be stopped. The pumps just held their own at the shafts and were able to empty the tunnel when the crevice finally clogged.

A solid bulkhead was now built across the heading to shut off the water. Back of this bulkhead, an emergency bulkhead was built that could be closed quickly in case of an accident. The procedure, when constructing a bulkhead against the pressure of water, was: To place drain pipes through the bulkhead, through which the water flowed, while the concrete gained strength. The valves were then closed and the water stopped. In the emergency bulkheads, the openings for passing cars and workmen were fitted with drop doors that could be released from without, by pulling a cable, instantly dropping the heavy steel doors and saving the rest of the tunnel.

When the bulkheads were completed and the tunnel unwatered, grout was forced through the solid bulkhead, using the drain pipes, and the heading beyond completely filled with concrete. A pressure of 200 lb. was used on the grout. After the concrete had set, a small drift was driven through the bulkhead and this concrete until the old working face was regained. The flow of water increased in spite of every precaution, until the pumps were handling 2000 gal./min. and the water was standing four feet deep at the working face. This was intolerable. The rock ahead for 200 feet was explored with diamond drill holes without finding better rock. It was decided to bring the full heading up to the old working face and then abandon work on this end of the tunnel, completing the work from the other side of the contact, advancing the Astoria tunnel. The grade of the tunnel caused the water to drain toward the working face on the Bronx end, while it drained away from the face on the Astoria end, giving better working conditions. By August of the next year the Bronx end was full-sectioned to the heading, an advance of 112 feet. During this time seven temporary bulkheads were built to stop floods, and flows of as high as 4000 gal./min. were handled by the pumps. The connection of the crevices with the river above was so free that beach sand and coal were carried down into the tunnel from the debris in the channel. On August 27, 1912, work ceased at the Bronx heading with the old working face regained and protected with a massive bulkhead.

In the mean time, the Astoria end of the tunnel was progressing at a rapid rate, only small flows of water being encountered. The contact with the dolomite was crossed without danger and the tunnel driven through into the hard dolomite. This rock was so firm that the waste was used as coarse aggragate in the concrete lining. The real trouble started when the Bronx contact was approached from the south, a distance of 3138 feet from the Astoria shaft. With the experience of the Bronx heading fresh in mind, the pumping plant was increased to 6200 gal./min. The grouting pressure was increased to 500 lb., the old pressure of



Geological Cross-Section of Tunnel Site.

200 lb. proving insufficient against the high pressure of the water. The working face was always protected with an emergency bulkhead similar to those described for the Bronx tunnel.

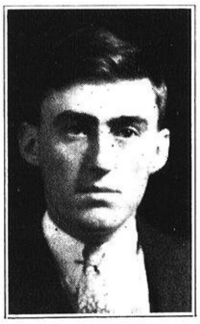
The work progressed slowly with few serious setbacks. As each advance was finished and the heading cleaned, a

(Continued on page 68)

Development and Progress of

Vertical Transportation

By Cyrus H. Heigl, m'32



Cyrus H. Heigl

NECESSITY is often called the mother of invention, but laziness and not necessity appears to have mothered the invention of the passenger elevator. There is no mention made in Biblical history that provisions for passenger elevator service were made in the unfinished Tower of Babel. And, perhaps, there was no urgent need for such equipment, because the people of that age were primarily interested in reaching Heaven, the long and weary climb being a small investment compared to the ultimate reward. In the event that the tower would have been completed, elevator service would have been too easy a means of gaining eternal sunshine and bliss.

The history of the elevator begins along about the time of Archimedes, when Archimedes himself designed an apparatus for vertical transportation, which consisted of a simple hand-operated winch. Hatchways evidently for elevators, have been discovered in the ruins of the palaces of Nero and Caesar. During the reign of Louis XIV of France, a French builder named Velayer, made a kind of elevator which he called the "flying chair". This elevator marked the first important improvement by the introduction of a counterweight, the basis of modern installations. These "flying chair" elevators became very popular, but due to an accident to the King's daughter they suddenly ceased "flying" and very soon disappeared altogether.

Only in the eighteen fifties did the elevator enter into a period of industrial development. At that time, the elevator known as the Vertical Screw Railway was invented by Otis Tufts and first installed in 1859. This elevator was driven by a vertical screw which passed through a nut fixed to the car.

Along about 1865 the hydraulic "ascenseur" was invented by Edoux in Europe. This type of apparatus soon met with a great demand as water, as a source of power, was very cheap at the time. This type of elevator was popular until near the end of the nineteenth century, when electric elevators became the object of serious study due to the steadily rising prices for hydraulic power in all countries. By 1895, in a single electric system in New York, 250 electric elevators had been installed, totaling 3000 H. P., with an average power of 11 H. P.

America was soon far in advance of other countries in the development of electric elevators. This advance was to become steadily greater for the following reasons:

The growth and unification of American electric power systems;

The development of huge blocks of buildings of ever-increasing heights.

In fact, after the development in 1898 of the structural steel type of construction as applied to the modern buildings of many stories, and the granting of one of the most important Push Button Control patents to the Otis Elevator Company during the course of the same year, the progress of the electric elevator in America was of such magnitude and rapidity that it was phenomenal.

Progress in any art always involves development, and, during the past decade, of no mechanical art has this been more true than in elevators. The first electric elevators operated on direct current. The development of multiphase induction motors enabled elevator manufacturers to design the first equipment to run on alternating current about 1905. In the course of later years, the progress has been so rapid that it can hardly be recorded. Successive introductions of two-speed multi-phase motors with interval resistance induction motors, micro-drive machines, gearless machines, Multi-Voltage Control, Signal Control, and many other improvements have placed the elevator development far beyond the wildest dreams of even ten years ago.

Today the elevator is such an important part of our everyday life in the cities that fame, for an American architect, is acquired by designing successful elevator halls, entrances, and cars. Increased economic pressure plus the zoning laws in our large cities have brought about a constantly accelerated growth in the size and height of buildings, both of which at the present time, have reached a maximum in the Empire State Building. Whether the skycraper caused the elevator to develop or whether the elevator made possible the skycraper may always be a matter of question.

Ten years ago, the zoning laws in New York City had brought about the design of tower type buildings built upon comparatively small ground area. This led to a restriction in the area of the upper floors that, coupled with the distances traveled and the corresponding time consumed, presented an elevator problem that resulted in the development of semi-automatic, high-speed, signal-operated, push button elevators, now common in by far the largest number of tall buildings since built countrywide. Thus speed was attained with safety. Good elevator service was then possible in such buildings without too great a reduction in the available rental yield or occupiable space — one of the most important problems the architect faces in the design of a large building.

The competition in height of buildings has been momentarily halted by the completion of the Empire State Building. The elevator problems encounterd in the design of this building were staggering in their magnitude. New possibilities included higher speeds, the double-decked elevator, the duplex elevator (or two independent elevators operating in a single hoistway), intermediate landings, and the "plaza floor". All of these new possibilities were discussed with the owners of the Empire State Building, but it was finally decided to lay out the elevator plant on the basis of a tried and accepted method. This, of course, put a limitation on the building height.

The recent elevator installations in the Empire State Building are wonders of mechanical perfection. The new high-speed elevator is as tireless and as sure as an adding machine. Heavy doors unlock, open, close, and relock by themselves. The car always does what it is electrically told to do with almost mysterious sensitiveness. The old time elevator control man is now just a button pusher. Except for the pressing of the button the elevator operates entirely without the handicap of human error. The acceleration and retardation is calculated for physical comfort, but no more. The elevator in this elaborate system of vertical transporation is protected against all hazards by a series of relays, switches, and mechanical safeguards. Vertical transportation today is much further advanced than railway transportation.

But, the new possibilities being investigated in the design of future elevators will soon wipe away the present limitations on the height of buildings. The time saving due to higher speeds is obvious. However, the old New York safety rules, now hopelessly out of date, fixed 700 feet per minute as the maximum safe speed, while building corporations and engineers want 1200 feet per minute. In fact, engineers even now talk confidently of speeds of 2500 to 3000 feet per minute, the apparent limit being the limitations of the human organism.

As the floors of buildings are usually of uniform height, double-decked elevators may be used with access from two landings. Passengers going to odd-numbered floors would enter from the lower landing and travel in the lower compartment, and passengers going to the even-numbered floors would start from the upper landing and travel in the upper compartment. Through this means the carrying capacity of a car would be doubled without increasing the hatchway area and the number of stops reduced to one half of the number of floors served. In actual practice a gain of 75 per cent could be expected with this system.

Running two elevators in the same hatchway is a novel, economical, and, due to the great advancements made in safety engineering, a feasible method of increasing capacity about 75 per cent. The upper car would leave its starting level ahead of the lower car, and return after the latter's arrival, serving a group of floors above the group served by the lower car. The schedule of the cars would be controlled by a block-system as used on railway lines, while inside each car a minature traffic signal of the conventional red, yellow, and green color scheme would inform passengers that the slowing down or stopping of the car was automatic and due to the close presence of the other car.

Elevators may in the future stop opposite intermediate landings situated between the actual floors, with short ramps connecting each intermediate landing with the floor above and below. Obviously only half the number of stops would be necessary, but the ramp idea is not popular.

The "plaza floor" scheme consists in dividing the building horizontally into two or more super-imposed buildings, so far as elevators are concerned, each elevatored separately. The main terminal landing, or "plaza floor", in each such division of the building is served by large express elevators from the street level making no other stops.

When the future Towers of Babel poke their peaks far up into the heavens, new and manifold problems will face the vertical transportation engineer. He has already developed his design to a high point of perfection, but when time demands he will be there ready to install his latest and best equipment.

Construction of New Subway Offers Problems

By HERBERT H. KIECKHEFER, e'33

THE engineering and geological problems which were encountered in the construction of the 8th Avenue subway in New York City are typical of those encountered in ordinary tunnel work, and yet they are unique since the work had to be carried on without danger to the structures and traffic on the surface.

The new subway was begun in 1925 and will be ready for use next month, having a length of 12 miles and carrying four tracks the greater part of its length. The bulk of the construction was done in an open ditch with no particular difficulty. Near 175th Street where the tunnel had to be blasted out of solid rock one of the main difficulties was encountered. The 175th Street station is a cave which can be reached only by elevators, the shafts of which were dynamited out of the bed rock. Since the station is built under the foundations of several skycrapers, an elaborate system of underpinning had to be devised to allow the blasting. Forty-foot pits were dug under the foundations and reinforcing of steel and concrete resting on bed rock was put in.

In one district the subway runs directly under an elevated line, and in tunneling under the elevated, 99 columns had to be supported on masonry until the tube was completed, and then the loads had to be carefully transferred to the roof of the subway.

The massive Columbus monument and the existing Interborough tube at Columbus Circle presented further difficulties. The existing line and the heavy monument had to be supported, and blasting had to be scheduled to avoid interruption of the train service on the Interborough line.

Completion of the 42nd Street station required the removal of 111,000 cu. yds. of rock and 45,000 cu. yds. of

(Continued on page 66)

Editorials

CAMPUS RACKETS One of the better known commercial humor magazines devotes a page monthly to campus rackets existing on the various campuses. While it exposes many of the elusive schemes by which the less scrupulous of the students manage to leach the suckers, we have to date seen no mention of one of the biggest and best organized of all the campus rackets.

The college annual, which should be a book by and for the student body, has sent out its annual contracts for page space. Organized campus activities are expected to fall in line and cough up $40 from some given vault for the privilege of being represented in the book which purports to be a summary of campus life. Support of such a book to the extent of covering the cost of publication should be expected of those organizations which can afford to give aid; but having had some contact with the publishing business, we are dubious as to the price set by the staff on page space. A cut costs possibly $5 and the cost of publishing the book on a page rate might reach $15 per page under proper management. Somewhere there is a considerable sum which escapes notice; perhaps there is a reason why former editors and managers have been known to blossom forth in new clothes, extended tours, and improved transportation after the termination of their year's work; perhaps there is a reason why last year's staff instituted a new tradition and changed the book from a junior to a senior publication, and then magnanimously stepped in and filled the thus vacated staff positions themselves.

THE STUDENT YEAR BOOK We have on the campus an annual publication which lists in order of founding the various organized campus groups. In addition it gives a chronological record of campus activities and is prefaced with a given amount of biography as being the accepted standard in modern college annuals. The art work is done by commercial artists in Chicago; photography is the product of commercial photographers; the inside pages are filled mainly with panels designed by the artists; and yet it is called the students' book.

Is it another of the functions of the growing school to outgrow its own talent — talent which would give the book real value as a souvenir of college life? Is the publication of a book which is perhaps a little rough in execution, but none the less an honest product of student work, taken as the sign of a small school such as could be expected to stage snake dances in the streets after football games? Let the book be the result of our own work — it will have infinitely more value to its owner — and the publication expense may be cut down to the point where the less fortunate of the organizations can afford to be represented.

TAG, YOU'RE IT The Madison city fathers have been attacked by another brain storm in the matter of traffic direction, and as a result the Capitol Square and a given length of State Street are decorated with new red and green and white lights, which add no end to the Christmas air of festivity, but leave traffic in a hopeless muddle.

The drivers of those cars which venture up onto the square have a somewhat insane and hunted look in their eyes. On every side of them lights flash green, red, amber, white, in a bewildering mess of color. Police stand on the corners blowing their referee's whistle every few seconds to announce a foul by one of the players. Students have developed a game to see how far they can go before they are stopped by a light. The record to date stands at two blocks, with little hope in the near future of bettering the record.

If there were a traffic problem on the square which needed a solution, it would doubtless be well for those in charge to attempt to organize the situation; but when the traffic is as insignificant as it is on the square, with the possible exception of a few minutes twice a day, it seems ridiculous to block it and jam it up with any such contraptions as have just been installed.

AND THEN THERE'S THE PEDESTRIANS Those Christmas tree lights on the square have succeeded not only in baffling the automobile traffic, but they have the pedestrians playing hop-scotch and looking furtively over their shoulders to see if it's fair to step out into the street. The lights all turn red. Traffic stops with due caution. A man steps off the curb, only to be whistled back to his one-yard line by the cop. He stands there and wonders, and presently another lens on the signal beams forth a brilliant white, in addition to the existing red. Again the whistle blows, and with a due amount of misgiving and doubt, people begin to step gingerly into the gutter to see what effect it has on the man with the whistle.

The whole business is ridiculous as a serious attempt to cope with a non-existant situation, and reminds one of the famous old "safety" islands over on University Avenue which still stand like tomb stones marking the scene of countless lost fenders, and an appreciable number of lost lives.

ANOTHER LOST BATTALION Polygon, all-engineering society, recently sponsored a successful and entertaining smoker in the Union. The entertainments were well received, the free cigarettes were smoked, and the beer and pretzels gave admirable aid in effecting informality. The chemicals came out of their little brick building on Park Street, and, forsaking their retorts and beakers for a brief moment, joined the affair, bringing back to our acquaintance people long-since given up for lost. A few mechanicals yielded to their curiosity and came in from their new playhouse, leaving the steam and gas and E A, to remind us that those men *had* been in school at that.

With the school growing and expanding into separate buildings, much of our old family atmosphere has left the college. They are mostly civils now, who stand on the front steps to yell at the lawyers and watch the co-eds scramble to their classes. The scope of our acquaintance is narrowing to our own department. In an effort to combat this retraction into our respective corners with consequent loss of entente between departments, Polygon is sponsoring a dance for the whole college to be held in the new building on December 11. Such an affair promises good entertainment and a unifying effect on the college, and merits the backing of the entire college.

FINANCIAL HONORARIES The season of election to honorary fraternities is under way and the successful grade point chasers are being plead with and beseeeched to join this and that. The invitation letter carefully outlines the purposes of the fraternity and the honor and dignity that go with membership in the secret clan. As a mere aside, and quite apart from the rest of the dissertation the fact is mentioned that one is expected to send in a check for $25 with his acceptance.

The very fact that $25 is required for acceptance is making men more skeptical of the honoraries. The societies are finding it rather hard to convince the more indigent of the scholars that there is $25 worth of value in the meaning and appearance of one more gold key on the watch chain. In spite of the bill-boards, there appears to be a depression, and men don't find any wild enthusiasm to toss out $25 unless they are sure they will get returns.

And does the honorary give value for value? Why should a society which meets only a few times during a man's active membership need such a heathy wad from each member? The trouble lies with the national organizations. The local chapters are powerless to reduce initiation fees when the national fraternity demands exhorbitant sums for each registry.

Where does the money go that is folded into the envelope and sent down to the national office? There must be leaks somewhere, or else the honoraries are suffering from mismanagement and lost purpose. An honorary fraternity should be so constituted that those who are eligible are honored, regardless of the size of papa's purse.

HE'S ONLY THE ENGINEER A note in one of the newspapers states that at the dedication of the George Washingotn Bridge recently, Cabinet members and others all had their say. That is, all except O. H. Ammann, the chief engineer, whose genius made it all possible.

And that is only too true of many of our works. Political figures see good publicity, and the mere fact that some other man was the one responsible for the existence of the structure bothers them not at all. New Yorkers know the Empire State building as Al Smith's building, although it is doubtful whether Mr. Smith is aware of the fact that the columns are subjected to sizeable bending moments when the wind blows, or for that matter, his knowledge of the manner in which the building is supported is probably very limited. Still, it's Al Smith's building, and the bridge will probably be somebody's bridge; and the names of the engineers who made them possible will remain signatures on the plans, and names on the pay-roll. The engineer is a meek and long-suffering beast content with erecting giant playthings for the public, and satisfied to have been successful in the solution of an unsolvable problem.

TO WHAT END ARE WE WORKING? Statistics recently made public show that 33 per cent of the engineers enrolled in the University of Wisconsin are either wholly or partly self-supporting. It seems a shame that such a great percentage of the future builders and planners should sacrifice everything just for the sake of a good education in our so-called prosperous country. After they have gone through a veritable hell such as this for four years, what then? They may be unlucky enough to graduate during a time of depression much like the '30 and '31 men have, and look many a moon before they can find a place where they can put to work their hard earned education. We admire courage of these men who wear themselves to a "frazzle" to obtain an education which they hope will help them to success in later life. They give up their social asperations, the benefit they would receive from participaion in extra-curricular activities, and some of them almost give up eating and sleeping to grind out an education.

Many would give up and say "What's the use?", but not these men, they stick to the finish. That's the type of spirit that wins in any man's game. More power to you.

— H. H. K.

GIVE US A HAND It seems to be the desire of the faculty to impress us striving engineers with the slimness of our chance for success after we leave this institution. Little quips about eighty-dollar-a-month jobs and "lucky to get that" are thrown out all the time by our instructors and profs. We hear short lectures about six years on the drawing board on the long hard trail to success, and are constantly reminded that we can't expect much, times are hard and are going to be hard, and only a few of us will ever get within shouting distance of the top.

Perhaps that's what we need to keep us from getting swell-headed, of having too high hopes about a rosy future. But it seems to us that about this time it's too easy to look at it the other way and think, "if that's where we're going, what is the use of all this struggle anyway?" Not many of us think we are hooking a ride on the silver-plated limited to riches. We know it's going to be tough. Right now what we need is a little encouragment. Perhaps if our faculty would paint the future before us with a little more life and color, we might put a little more life and color into our work.

— H. E. P.

Alumni Notes

Among Our

Successful Wisconsin Engineers

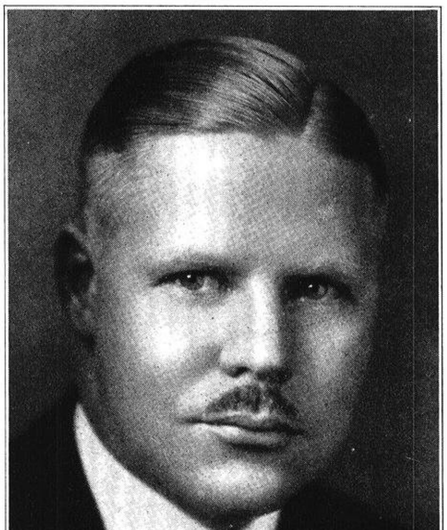
is

Merrill Edmund Skinner

A way back in 1913-14, a basketball team representing this College of Engineering plowed through all opposition in an intercollege tournament to win the championship with five wins and no losses. Playing guard on this stellar aggregation was fair-haired hustler who was successful in mixing athletics with scholarship. He not only won his '14 numerals, but he made Tau Beta Pi. Then he went out to make his fortune and proceeded to show that the combination of brains and energy, when properly directed, brings home the bacon. Today he is vice president of the Niagara-Hudson Company of New York and directs the sales of that organization. His name is Merrill Edmund Skinner.

Merrill Skinner is the son of Professor Ernest B. Skinner of the department of mathematics of the University of Wisconsin. His parents came from Ohio to Madison in 1892. Merrill was born on March 14, 1893, and grew up in the university atmosphere. He attended Central High School from which he was graduated in 1910. He entered the university that fall and majored in chemistry with minors in mathematics and physics. He received the B. A. degree in 1914. He then spent one summer session and one full year in the College of Engineering, and received his B. S. in electrical engineering in 1915. He left upon his instructors a strong impression of energy and enthusiasm.

Following graduation, Skinner became a student-apprentice with the Westinghouse Company, where he had



Merrill Edmund Skinner

the privilege of working under the late B. G. Lamme, an outstanding figure in the electrical field. At the end of a year he was made transformer engineer. His designs quickly gained him considerable reputation throughout the country. The transformers at Prairie du Sac are of his design.

After spending five years with the Westinghouse Company, he accepted a position as assistant to the general manager of the Duquesne Power & Light Company of Pittsburgh. His work was successful and he was made general manager. By this time he was no longer designing equipment; he was selling power and making a reputation in that field as he had done in the field of design. During this period he did a good deal of technical writing and was active in the Pennsylvania Electrical Society.

In 1926, Skinner made his next move; he went to Albany, N. Y., to become sales manager for the Mohawk-Hudson Power Corporation. A year later he was made vice-president of the New York Power & Light Company. The Mohawk Company was absorbed by the Niagara-Hudson Company in 1929, and Skinner became vice-president in charge of merchandizing sales for the latter company. He took up residence in Buffalo, where he is at present.

Mr. Skinner was married in 1916 to Viola Ella Dillman of Madison, who was then a student at the University of Wisconsin. They have no children.

His liking for active pleasures has remained strong, and he finds relaxation in golf, motoring, and swimming.

MECHANICALS

Aspell, E. W., m'29, is with the Barber Coleman Company of Rockford, Illinois.

Breiby, Norman, m'30, is back in Madison at 149 Jackson Street.

Cowie, Alex, m'31, is a graduate student at the University of Michigan.

Dewey, W. V., m'30, is instructor in Steam Engineering at Penn State College, State College, Pa.

Dresen, J. H., m'20, is with the Western Electric Company in Chicago. Joe spent Thanksgiving with his father and brothers in Madison.

Engelke, Robert, m'30, is in the bridge department of the Wisconsin Highway Commission. Address: Capitol Annex, Madison, Wisconsin.

Fyfe, Clayton, m'29, is research engineer with the Oilgear Company of Milwaukee. Clayt is happily married and has hopes.

Gerlach, H. W., m'29, is enrolled as a graduate student in the College of Agriculture.

Kraut, Ralph J., m'29, has left the A. O. Smith Corporaiton of Milwaukee and is now with the General Electric Company at Schenectady.

Leasmann, Emil L., ch'07, retired Milwaukee chemist, was found dead in his laboratory recently. It is believed that he was poisoned by carbon monoxide gas while engrossed in an experiment.

The college is sorry to learn of the death of Steve Polaski, Sr. **Steve Polaski, Jr.,** m'26, was captain of the 1925 football team.

McGourty, F. J. m'29, is with the C. M. St. P. & P. road with headquarters at Great Falls, Montana.

Puerner, Bert H., m'20, with his wife, was a Homecoming visitor at the college. Puerner, who is with the Allis-Chalmers Company, has recently returned from Russia. He spent a year in the Soviet States as representative of the company.

Steckler, Norbert, m'31, is at the Sheffield Scientific School, Yale University, where he is enrolled as a fellow in the graduate school.

Stewart, Fred C., m'23, is assistant professor of Steam Engineering at Penn State College, State College, Pa.

Vilter, Ernest F., m'27, address: 3627 Humboldt Avenue, Milwaukee, Wisconsin.

Wilson, Walter T., m'30, former staff member of the Engineer, is enrolled in the graduate school, taking advanced work with the Mechanics Department.

CIVILS

Bourkland, Walter M., c'31, has been with the Wisconsin Highway Commission since September 1 as chief of party. Address: 1119 State Street, Eau Claire, Wisconsin.

Dunn, Clark A., c'23, writes, "I have changed my profession and can sympathize with the instructors in all of their trouble with students." Address: Oklahoma A and M., Stillwater, Oklahoma.

McMullen, Ralph E., c'27, senior engineer inspector foreman with the U. S. Bureau of Public Roads in Glacier National Park, on the Logan Pass section of the Transmountain highway now has his headquarters in Portland, Oregon.

Merkin, Abraham L., c'10, is assistant engineer with the Board of Transportation of the City of New York, in the bureau of design. At the present time he is engaged upon the design of the proposed Sixth Avenue subway. For a few months after graduation he was computer for a consulting engineer. He then spent seven months in office work for the Board of Public Works of New Rochelle, N. Y. From May, 1911 to Sept. 1915, he was with the Board of Water Supply of the City of New York on the construction of the Catskill aqueduct. From Sept. 1915 to May, 1917, he was with the Bureau of Sewers of Brooklyn. Then he spent eight months on the construction of a steel mill with the Dravo Contracting Co. of Pittsburgh. From Jan., 1917 to July, 1919, he was with the Public Service Commission of New York City in the track division doing both field and office work. His connection with the Board of Transportation began in August, 1927.

Stewart, R. W., c'19, address: 1200 Arapahoe Street, Los Angeles, California.

MINERS

Barker, George J., min'20, professor in the department of mining and metallurgy, has recently completed a series of tests in co-operation with Prof. McCaffery to prove the quality of magnesium lime mortars found in the state. Approximately 10,000 specimens of Wisconsin lime mortar have been tested, and although the tests have been successful in proving the quality of the state's magnesium lime mortars, they are being continued for further discoveries.

Jones, T. D., min'22, Chief Metallurgist, lead and copper plants of the American Smelting and Refining Corporation, Raritan, N. J., is the inventor of a new process for removal of tin from antimonial lead and alloy upon which patent No. 1,821,643, September 1, 1931, has been issued.

Knoll, Waldemar A., min'14, address: 709 East Ayer St., Ironwood, Michigan.

Lorig, C. H., min'24, MS'25, PhD'28, of Battelle Memorial Institute addressed a meeting of the Wisconsin Gray Iron Foundry Group in Milwaukee on November 11, 1931. Dr. Lorig took as his subject the influence of molybdenum on the properties of cast iron. He has recently published a comprehensive paper on this same subject.

ELECTRICALS

Ackerman, A. J., e'26, writes that he is sailing for the Panama Canal Zone December 15th to be engaged on the construction of the Madden Dam for the next three or four years. Ackerman has to date been designing engineer with a contractor in St. Louis.

Kurtz, Edwin B., e'17, professor of electrical engineering at the University of Iowa, is the author of a bulletin on "Oklahoma Wind-Electric Power", published by the Oklahoma Agricultural and Mechanical College. He prepared the material while he was head of the electrical engineering department at the Oklahoma institution. The bulletin gives the results of a series of observations on a wind-electric installation near Enid, Oklahoma. Within the past eight years a number of these plants have been built in that state. They have a two-blade, airplane-type propeller and charge a storage battery. An automatic rudder keeps the wheel in the wind and turns it out of the wind when the velocity exceeds 25 miles per hour. They are able to supply the lighting load on a farm and also power for washing, ironing, toasting, cleaning, fans, and pumping water.

Seastone, John B., e'26, who is with the Westinghouse Electric Co., was married to Alice Jean Williams of Pittsburgh on Friday, November 20. After a motor trip through the east, Mr. and Mrs. Seastone plan to be at home at 206 Newport Road, Wilkinsburg, Pa.

Campus Notes

ENGINEERS DO QUEER THINGS AS SCABBARD AND BLADE INITIATES

Guarding every sorority house on the campus and hailing everyone who passed, serenading girls, carrying cigarettes, oranges, Hershey bars, gumdrops, and army rifles, the Scabbard and Blade pledges spent a busy evening for their informal initiation. Scabbard and Blade is the honorary military fraternity. Twelve of the thirty-two initiates were engineers, and here they are: George C. Anderson, e'33; Louis J. Bohm, e'33; Lawrence Collins, m'34; John R. Canright, min'33; Richard Engholt, e'33; Lorenz A. Leifer, e'33; Clyde F. Schleuter, e'33; George P. Schipporeit, c'32; Royal G. Thernn, m'33; Harry A. Trelevanch, '33; Charles W. Wright, e'33; and Aubrey Wagner, c'32.

McCAFFERY PRESENTS PAPER ON BESSEMER STEEL

A paper on "The Bessemer Process and its Product" that was presented by R. S. McCaffery, professor of metallurgy, on October 23 before the American Iron and Steel Institute is being printed in *Blast Furnace and Steel Plant*. The first installment appears in the November issue of the magazine. In the paper Professor McCaffery describes how the Bessemer Process, the first to produce steel on a large scale, may be used to produce steel of a quality good enough to compete with other methods. Until very recently it was supposed that the Bessemer Process produced an inferior grade of steel.

PROF. JANDA PREPARES REPORT ON HIGHWAY "FROST BOILS"

The first step in the state's plans for the elimination of "frost boils" from the Wisconsin highways was made in the presentation of a report on the causes and remedies of the condition which was made by H. F. Janda, professor of highway engineering. Professor Janda conducted an investigation in many parts of the states during the last two years as a special investigator for the state highway commission.

A NEW TEST FOR STRUCTURES

A novel method of testing steel structures is described by the following news item, taken from the *Daily Cardinal:*

TESTS SHOW THAT BLEACHERS SWAY .005 INCHES IN THE WIND

The new permanent bleachers at Camp Randall sway only .005 inches, tests at the stadium Wednesday showed. The physical education department took several gym classes to the field to test the stands, because of report that at recent football games the sway amounted to two or three inches, and gave spectators some uneasy moments.

NARROW MEASURE ON QUOTATION

It might be suggested that the mechanics department provide for a phy-ed test of beams in their new laboratory in the engineering building. Three gym classes of phy-eds is a rigorous test for anything.

PI TAU SIGMA INITIATES ELEVEN

After having spent several weary hours in casting and filing their plaques eleven mechanicals were initiated into Pi Tau Sigma, honorary mechanical engineering fraternity. The formal initiation was held on November 8 in the Memorial Union. Seven seniors and four juniors wear new keys. They are the following: Marlin Baker, m'32; Rudolph Dobrogowski, m'32; Cyrus Seigl, m'32; Stratton Hicks, m'32; Aake Janessen, m'32; Frederick Stolz, m'32; Donald Anderson, m'33; Lawrence Heger, m'33; Elmer Kaiser, m'33; Charles Novotny, m'33; and Royal Wood, m'33.

LOUIS KAHLENBERG TELLS OF FARADAY

"Faraday knew very little about mathematics, and did not have the advantages of an education, yet he made discoveries which laid the foundation for modern electrochemistry and electrical engineering," declared Louis Kahlenberg at a lecture on "The Life and Discoveries of Michael Faraday". The lecture was sponsored by Phi Lambda Upsilon, honorary chemical fraternity, and was given in the chemical auditorium on November 8.

In his talk Prof. Kahlenberg gave an account of how Faraday pointed out the main laws of electrolysis upon which the science of electrochemistry is based. Faraday's chief difficulty did not seem to be in formulating of momentous laws of nature, however. Sir Humphry Davies' young wife took a distinct dislike to Faraday, and did all she could to make life miserable for her husband's protege. Mrs. Davies declined to attend a banquet if Michael Faraday were to be there. The revenge of Faraday's persecution was attained when the host penned a letter to her saying that he was very sorry that she chose not to attend the banquet.

Although Prof. Kahlenberg's lecture was intended primarily for members of the chemistry department, it was well attended by engineering students and faculty members. The lecture was timely since this is the 100th anniversary of the discovery of the theory of electromagnetic induction.

EXTENSION DIVISION REVISES HIGHWAY COURSE

An oppotunity to study highway engineering while employed is offered by the course in Roads and Pavements, recently revised by the University Extension Division. The course is conucted by H. E. Pulver, professor of civil and structural engineering. The course includes instruction in surveys and plans, the economics of highways, design of rural roads and city streets, the operation and maintenance of various types of roads, and traffic regulation and control.

PI TAU PI SIGMA PLEDGES SEVEN ENGINEERS

Out of eight men pledged recently to Pi Tau Pi Sigma, honorary Signal Corps fraternity of the R. O. T. C., seven were electrical engineers. The following men were pledged at a luncheon held in the Memorial Union: Andrew Esser, e'33; William Kurtz, e'33; Frank Weinhold, e'32; Lorenz Leifer, e'33; Louis Bohm, e'33; George Anderson, e'33; and George Halamka, e'33. Professor Chester Lloyd Jones, director of the school of commerce, spoke on American foreign policies.

PROFESSOR MEAD HONORED BY A. S. C. E.

Daniel W. Mead, professor of hydraulic and sanitary engineering, was one of four outstanding American civil engineers to be elected to honorary membership in the American Society of Civil Engineers at a meeting of the board of directors of the society in November. Professor Mead is to go to New York in January to receive the honor.

With his election, Professor Mead becomes one of the eighteen men in the world who have been made honorary members of the society. The three others who are to receive the honor with him in January are George W. Kitteredge, retired chief engineer of the New York Central Railroad; George H. Pelgram, chief engineer of the Interborough Rapid Transit Company; and Palmer C. Ricketts, president of the Rensselaer Polytechnic Institute.

COMMUNICATIONS LAB TESTS NEW TUBE

Amplifications of ten thousand million million times, or more explicitly, 10^{18} times are being played with by men in the Communications Lab under the supervision of Mr. Benedict. The new low grid-current pliotron FP-54 is the tube which serves as the medium for the incomprehensible amplification, and it is being tested for stability of operation in conjunction with a small, light-beam galvanometer. The value of the tube lies in the fact that in such a set-up it can be used with very high input resistances, where if just a galvanometer were used there would be no deflection on account of the comparatively high current drain of the meter.

HANSON TELLS ENGINEERS OF FOREIGN SERVICE

Few young American engineers who go to Central or South America under contract stay to complete the contract, according to Burton Hanson, a junior in the civil engineering course, who described his experiences in Venezuela before the student chapter of the American Society of Civil Engineers of Wednesday evening, November 4.

The discomforts of field work in the tropics and the monotony of a diet of steady work, according to Mr. Hanson, outweigh the romance of the job for many young men, but those who stick it out gain an experience they would not willingly renounce. Mr. Hanson signed on with the Creole Petroleum Company as a plane-table man at the end of his sophomore year and spent two years in Venezuela and Columbia.

The Americans who are assigned to a large city live in comfort and luxury; those assigned to the permanent camps of the companies devote their spare time to golf and tennis and suffer from limited social contacts and a monotonous routine; those assigned to field work have an opportunity to go places and see things if they can stand up under the life. They encounter some strange experiences, according to Mr. Hanson, who related how a minor native chief was so taken with the gold teeth of one of the American boys that he tried to arrange a marriage between the American and his daughter for the purpose of raising a crop of golden-toothed grandchildren.

Good health is essential for such a life, Mr. Hanson warned his hearers, and the young man must learn how to avoid sickness.

SMOKER AND DANCE ARE POLYGON'S LATEST

Clouds of smoke rolled forth from the Union and the floor was knee deep with beer as Polygon threw its all-engineering smoker December 2. The boys gathered in gratifying numbers in Tripp Commons, and while they slurped beer, dunked pretzels, and smoked cigarettes, they were entertained with speeches and small scale vaudeville. Izzy, Bob Neller's puppet, cracked wise about Louis Kahlenberg's head of hair, and was equally irreverant about the various other faculty members upon whom he could tie some sort of crack. Professor Dawson rose in a more serious vein and gave impressions of the recent war from the experience of one who had served four years. George Anderson fooled part of the people all the time with sleight-of-hand, or "magicianship" as Polygon's president called it; and by and large we all had a good time.

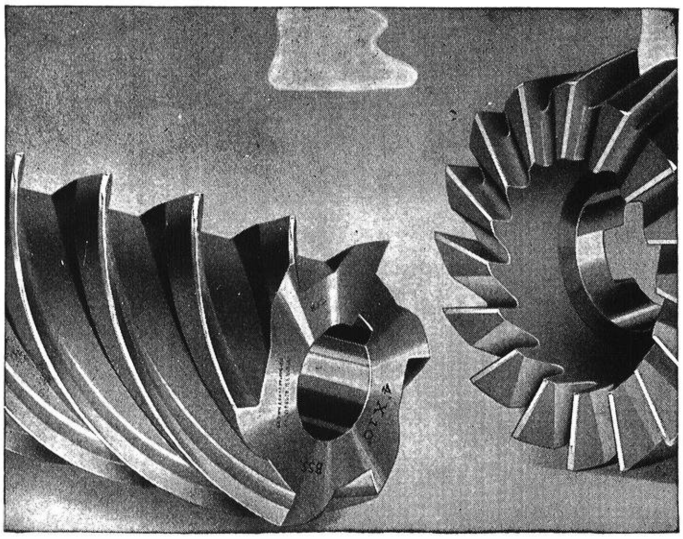
December 11 is the night set by Poylgon for its all-engineering dance to be held to the seductive strains of

Al Thompson's orchestra and amid the mysterious and alluring shadows of the mammoth engines of the new Mechanical Engineering Building. Friday night will find the place transformed from a structure of steel and concrete in which we ponder over machine design, and which we visit weekly to match our wits with the best of engines, to a shelter for the most unique party of the university social season. Nowhere else does one get the opportunity to park his brawny right arm on the fly-wheel of a Nordberg Compound Engine, drink in the admiration of a fair consort, and at the same time listen to the lilting music of a first rate college dance band. At no other time are the appreciative co-eds privileged to move in the select circles of some of the country's most modern prime movers and brush elbows with some of the very best generators and internal combustion engines. The affair promises to be at once unique and highly entertaining, and the small entrance fee is well covered by the potential value to be received.

DEGREES TOTAL 3740

Up to 1930, the College of Engineering has, according to Annie B. Kirch, statistician of the college, granted 3740 undergraduate degrees, distributed as follows:

Civil engineering course, 1876-1930	1097
Mechanical engineering course, 1876-1930	904
Electrical engineering course, 1892-1930	1217
Chemical engineering course, 1903-1930	386
Mining engineering course, 1910-1930	134
Metallurgical engineering, 1930	2
Total	3740



SUBWAY CONSTRUCTION PROBLEMS

(Continued from page 59)

earth. Upwards of 4,000 tons of steel and 15,000 yards of concrete went into the station, and during the construction 15,000 pairs of telephone cables, 100 power cables and sundry sewers, water mains, and gas mains had to be protected. The roof of the completed station will withstand a calculated load equal to that of a 25-story building.

Water presented its problem on the west side of the city where the tunnel ran into an underground stream requiring six pumps pumping 120 gallons per minute to keep the tunnel from flooding.

A rather amusing side of the difficulty encountered is the manner in which the light bulbs for the train cars are made. It seems that New Yorkers are in the habit of effecting personal economy by unscrewing the light bulbs and carrying them away in their pockets. To offer some resistance to this practice, the lights in the trains have all been equipped with left-hand threads.

RADIUM RADIATIONS DETECT DEFECTS IN STEEL

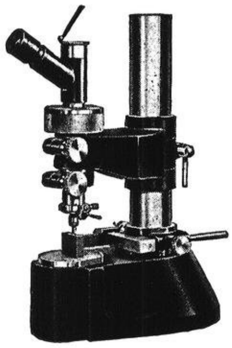
Gamma rays from radium can be made to shine through steel objects twelve inches thick and reveal their internal defects. Valves for high-pressure power plants and pipe lines can be made safe for use by this means. Battleship parts, such as the stern-post and keel knuckle, can be tested before the trial run is made. Welded parts can be inspected to be sure the welds are sound, and even to check the welding procedure before actual work is begun.

This method of testing reminds one, of course, of the shining of X-rays through thin objects for the same purpose, but it is simpler in some respects, although requiring especial procedures in other respects. It is surprising that these gamma rays, known about in general for nearly thirty years, should never have received the proper handling and adaption necessary to make them serve this useful purpose. Those dealing with radium in the past have been either "pure" scientists, interested only in understanding the nature of "matter" and "energy", or they have been biologists, interested in the therapeutic effects of radium on living organisms.

It remained for a mind trained in the science and art of metallurgy, but working in daily contact with research physicists and their theories of waves and of quanta, to evolve a method for the practical use of gamma rays in inspecting metal objects. These favorable conditions existed at the Naval Research Laboratory in Washington and there a program for developing the gamma ray method was evolved. Nearby, Baltimore had, at the Howard A. Kelly Hospital, a supply of radium. The hospital officials were willing to rent and even lend their radium to the Navy Department for the purpose in mind. Another metallurgist was called in, from Lehigh University, to take charge of the experimental program and carry it out.

Many discouraging prophecies were heard as the plans proceeded. Radium experts in New York assured the pro-

(Continued on page 72)



LIED TO THE LAST

Here lies a Lawyer
Laugh, if you will,
In mercy, kind Providence
Let him lie still.

He lied for his living,
He lived while he lied,
When he couldn't lie longer
He lied down and died.

DRIVING THE ASTORIA TUNNEL

(Continued from page 57)

number of test holes were driven ahead, radiating from the working face like a fan. If water was struck, the test holes were reamed out and pipes fitted into them, wedged tight with steel wedges. The mud and sand in the crevice were allowed to drain out and their place filled with grout. When the entire advance was dry, the work recommenced. When water was expected, pipes were set in reamed holes in the rock and the test hole drilled through the open pipe. This saved the trouble of setting the holes against a heavy flow of water. When the rock was not sound enough to hold the reaction from the pressure of the grout, a buttress of concrete would be placed against the working face or side and the grout pipes set into the concrete. Cotton waste was mixed with the grout to provide against erosion of the fresh concrete and to clog small leaks and crevices. When this preliminary grouting failed and the advance brought large flows of water, bulkheads were built across the heading and the heading grouted solid behind that protection. After the grout had set, the tunnel was recut through the concrete.

In January, 1913, the first crisis came. A small blast increased the flow of water into the heading to 4000 gal./min. Three bulkheads were built in succession in attempts to stop the flow of the water. The first two failed under the pressure, the water backing up behind the lining and breaking through behind the bulkhead. 1000 cu. yds. of sand were carried into the tunnel by the flow of water and 16 feet of heading were lost before the water could be stopped. The flow of water taxed the capacity of the pumps which handled 4400 gal./min. continuously for over a month. Every attempt to continue the work brought down more water. The openings into the river overhead were so large that live fish were carried down into the workings. The pumps were called on to handle 6058 gal./min. When the crevices were reached with drill holes and grouted under 500# pressure, the crisis was over. 3800 bags of cement were used in this one grouting. The rock through the trouble zone was practically converted into weak concrete. The main crevice was sealed and when a new advance was made, little water was encountered. From here on, the advance was through rock impregnated with grout. Up to this time, the grout had been driven outside the line of the tunnel to shut off the flow from above and the sides. Now the grout had saturated the rock. Every hair crevice was filled with grout. The engineers were able to study the action of their grout.

The danger seemed over and there were no incidents until the tunnel was holed through. Great care was taken and every advance protected by bulkheads. Twenty-two bulkheads were built to advance the work through 150 feet of rock. On July 17, 1913, the heading was holed through, three years after the ground had been broken for the first shaft.

There were now 474 feet of tunnel to be enlarged, from the small heading that occupied only the upper half of the cross-section, to the full tunnel section. The bench had been tested as the heading had progressed and no trouble from water was expected, the flow from above being cut off and no trouble having been experienced from below. The safety bulkheads were cut away to make room for the concrete lining and the work carried on unprotected. The work proceeded without incident until only 121 feet of bench, across the actual line of the contact, were left. The sketch shows this section of the tunnel.

On September 4, the second crisis came. A month later, the engineers saw their work wiped out and on October 7, the water in the flooded Astoria shaft and tunnel rose and fell with the tides. This is what happened: On the morning of September 4, a test hole struck water under full pressure. The rock was rotten and it was decided to build a buttress against the corner of the wall to allow the crevice to be grouted. While the buttress set, the drain pipes were left open to prevent back pressure. When the valves were closed, the buttress cracked and failed. Another heavier bulkhead was built. It failed. A third bulkhead, 128 tons in weight and braced against the roof of the tunnel with heavy timbers, went into place. When the valves were closed and the grout forced into the rock, the buttress was moved bodily away from the wall and cracked apart in two directions. Warned by the danger, two new safety bulkheads were built across the tunnel at the two ends of the bench, to save the rest of the tunnel in case of accident. They were constructed just in time. On September 12, a series of seams in the floor opened up and began discharging water and sand into the heading. Nothing could seem to stop the water and it kept increasing in discharge. When the flow partially subsided, October 6, the crevice having clogged, the tunnel was half choked with sand and refuse from the river bed above. The doors of the safety bulkheads were cleared, so they could again function. On the morning of October 6, the end came. As the workmen were building another bulkhead, the whole bottom of the heading opened up and water came in with a rush. The men ran for their lives. The Bronx bulkhead was closed and sealed, an old buttress in front of the door breaking the force of the water. At the Astoria end the men were not so lucky. The door slammed shut but caught on a piece of timber that the water had thrown across the sill. Some of the drain valves through the bulkhead were closed before the water swamped them out. It was afterwards found that an eight inch drain pipe had been left wide open. By four in the afternoon, the Astoria pumps went out of action and the water rose in the shaft, drowning them out. By the next morning, the water was rising and falling in the Astoria shaft with the tides.

The situation will be summarized. The entire pumping plant at the Astoria shaft was lost at the bottom of the shaft. The Bronx shaft was free, with the short section of the tunnel up to the bulkhead "B". The capacity of the pumps at the Bronx shaft was only 1,200 gal./min. to cope with a tunnel filled with 10,000,000 gallons of water, connected with the river through crevices that were capable of discharging not 1,200 gal./min., but 12,000 gal./min.

The first attack on the crevice was made through bulkhead "B". A drill hole was driven into the crevice below the floor of the heading, 120 feet away. This was grouted but without results. A hole was drilled through the bulkhead into the open space of the heading. Through this hole was placed a pipe that reached to the floor of the heading above the crevice. Through this pipe, grout was forced until the heading was concreted solid and grout appeared through the drain holes in the bulkhead. When this had set, the drain pipes in the bulkhead were opened and the heading pumped dry. When the head of the water was lowered twelve feet, the seal on the crevice broke and the heading was again flooded. Grouting was recommenced and not stopped until 10,000 bags of cement had gone into the heading and crevice. This time, the seal held and the crevice was stopped.

The new pumping plant at the Astoria shaft started on November 24 to pump the tunnel out. The ventilator pipes mounted in the shaft were converted into an 18-inch and three 8-inch air-lift pumps. Three pumps with a capacity of 1800 gal./min. were mounted on a pontoon floating in the shaft. A battery of pumps with a capacity of 3,600 gal./min. were mounted on the frame of the elevator shaft and lowered from bay to bay as the water went down. In addition, drain pipes were opened in the bulkhead "B" to drain the water between the bulkheads into the sump of the Bronx pumps. It was found that there was not a free connection between the Astoria tunnel and the heading section, the grout having at last closed the open drain pipe and opened door on bulkhead "A". The drains on bulkhead "B" discharged at practically full head, showing that the connection of the crevice to the river was still open and that all that the grouting had done was, to seal the door in "A". As the water went down in the Astoria shaft, the rising tunnel grade formed a water trap that built up a vacuum against the bulkhead "A" and held back 1,000,000 gallons of water. This was relieved by forcing air under 135 lb. pressure through an old ventilation pipe that ran completely through the two bulkheads and opened into the Astoria tunnel beyond the bulkhead. After a short time, the obstructions were blown out and the vacuum broken. November 28, the battery of pumps buried at the bottom of the Astoria shaft were recovered and assisted in unwatering the tunnel. 24,000,000 gallons were pumped in those four days. The portal was cleared on November 30, and the tunnel open for inspection.

The job now was to complete the cutting of the bench through the 121 foot section. The crevices through which the flood had come were partially closed but there was still 17 lb. head on the water between the bulkheads. Each bulkhead was supported with a second reserve bulkhead reinforced with steel rails. The danger zone was situated just beyond bulkhead "A" and could be most easily reached from that end. Short drill holes were driven into the seam on each side and a thorough job of grouting done. After 3000 bags of cement had gone into the crevice, it closed and the flow of water ceased. The doors were then opened and

ELECTRICITY
puts the news on the street before the fans leave the arena

AS THE fight ends and final reports flash in, the last newspaper plate is made up and locked on the press cylinder. With the tiny click of a push button, the snap of contactors, the whir of motors, the roar of press units, the fight edition goes to press. Each unit automatically controlled and perfectly synchronized with Selsyn elements — each section arrives at the folder at the correct instant. Sixty thousand papers an hour. To-day the dead-line is postponed — the news is red hot. The fight news is on the street before the crowd leaves the arena.

Since its beginning, the electrical industry has worked hand in hand with the newspaper industry. To-day, the high-speed, newspaper press, with maximum outputs of 50,000 and 60,000 papers per hour, owes no small portion of its success to electricity and the skill of General Electric engineers.

For the last 30 years, college graduates in the employ of the General Electric Testing Department have played an important part in the development of newspaper equipment. Here they gain experience which enables them to apply electricity to the advancement of this and countless other industries.

95-897DH

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES