The Wisconsin engineer. Vol. 20, No. 5 February 1916

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

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

The Wisconsin Engineer

Vol. 20 FEBRUARY, 1916 No. 5

CONTENTS.

The Wisconsin Engineer

VOL. XX FEBRUARY, 1916 NO. 5.

RECENT DEVELOPMENTS IN SHOW WINDOW LIGHTING REFLECTORS

By JOHN A. HOEVELER, B. S. 1911, E. E. 1914
Illuminating Engineer—National X-Ray Reflector Co.

In the issue of the ENGINEER for May, 1914, an article by Mr. Hoeveler, on "Illumination of the Show Window" appeared. This present article has been prepared to follow the earlier one covering the changes necessary because of the developments in lighting units.—EDITOR.

In a previous article the writer discussed the subject of window lighting, placing particular emphasis on the importance of good window lighting to the merchant. The well-recognized principle of illuminating the window from the front and above by means of numerous lighting units uniformly spaced along the plate glass was elaborated upon, and methods discussed for securing the best control and the most economical distribution of the light flux in various types of windows. However, this was in the days of the vacuum type of tungsten lamp. Since then the gas-filled lamp has become standardized in size as small as 100 watts. The more nearly white light of this lamp, and its greater efficiency at once made it a popular lamp for store window lighting, necessitating the development of new types of reflectors.

The construction of this lamp is entirely different than that of the vacuum style. The filament is wound in a helical coil and bunched near the center of the bulb, giving the lamp a different characteristic light distribution from the long straight wire vacuum tungsten lamp; the lamp is operated at a much higher temperature; the dimensions of the lamp are different. Consequently the reflectors require different shapes and sizes, and suitable means of dissipating the heat developed.

As mentioned in the former article, show window construction and methods of trimming, in recent years, have become quite well standardized. The drawing herewith represents in sectional view, the average closed-in window of dry goods stores, men's clothing stores, etc. The usual height from floor to ceiling is about 10 feet; the depth, plate glass to background, 7 feet; and the height of trim on background, 7 feet. The trim is carried out with the low and flat display placed at the front of the window, and the higher vertical objects at the rear. Consequently a line of trim'' may be drawn, to indicate approximately the surface that we should endeavor to uniformly illuminate. With this average line of trim determined, it is an easy matter to calculate the shape of light distribution curve required to give uniform lighting.

In Fig. 1, the curve A represents the light distribution from a single lighting unit that will give a uniform intensity of illumination on this assumed line of trim. The candle power values indicated are calculated to give 9-foot candles. It will be noted that the curve should embrace approximately the angle —5° to +75° (where the negative angle means the angle to the left of the nadir). This is a distinctly non-symmetrical distribution of light that is very difficult to obtain, but nevertheless can be closely approximated.

The mirror reflector has inherent characteristics which make possible the attainment of these results to a remarkable degree of exactness. A mirror is a specularly reflecting surface, and within certain limits the distribution of light can be varied. Because of the necessity of employing corrugations to break up the images of the filament and eliminate the resulting streaks and stria in the illumination, perfect control of light in accordance with the law of regular reflection is not secured.

However, securing the proper distribution of light is but one portion of the problem. Other factors must be satisfactorily solved. For instance, it will be noted that the upper part of the window background is usually of glass, to permit some daylight to enter the store. Where the glass is clear, the lighting units would be visible from the store interior, unless the reflector is designed so as to conceal the lamp filament from the view of the customers within. On the other hand in order that sufficient light may be delivered to the upper part of the background, the reflector must partly be open at the front. In practice, therefore, this opening must be sufficiently restricted to conceal the filament of the lamp and at the same time allow a sufficient volume of light flux to escape in a nearly horizontal direction to illuminate the upper part of the background. With the vacuum style tungsten lamp, the ideal results represented by curve A

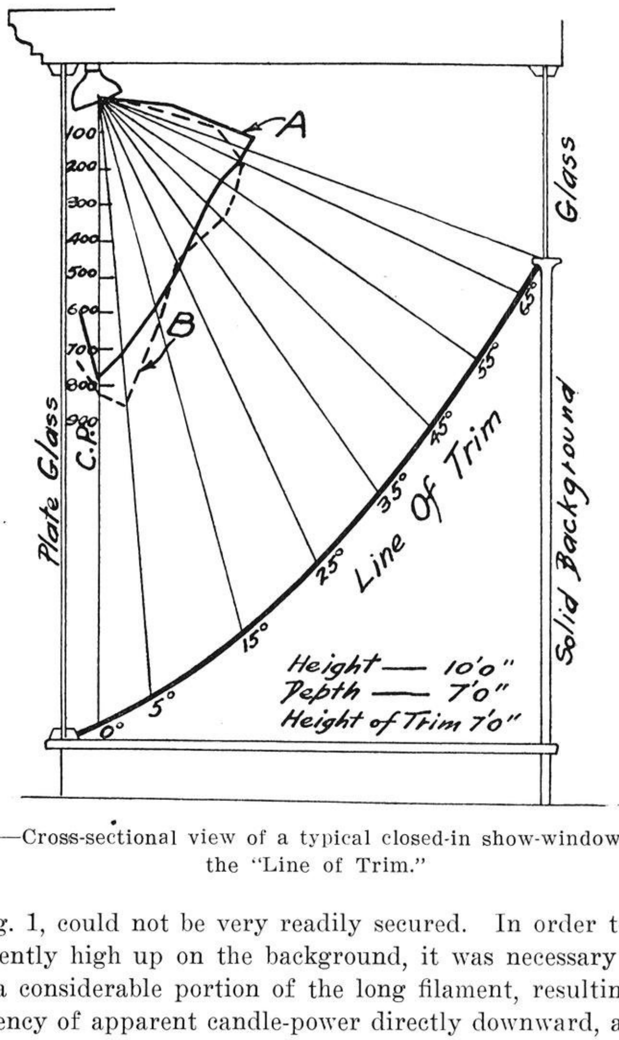

FIG. 1.—Cross-sectional view of a typical closed-in show-window. Note the "Line of Trim."

in Fig. 1, could not be very readily secured. In order to light sufficiently high up on the background, it was necessary to expose a considerable portion of the long filament, resulting in a deficiency of apparent candle-power directly downward, and too high an intensity on the background, as well as the possibility of a direct view of the lamp filament from within the stores.

The concentrated coil filaments of the new gas-filled tungsten lamps have simplified the attainment of these results.

Curve B of Fig. 1, shows the light distribution secured with a 100 watt gas-filled tungsten lamp and a silvered mirror reflector of special design. Fig. 2 shows the contour of this reflector and the relative filament position. Its light distribution curve approximates the ideal curve A very closely, and for all practical

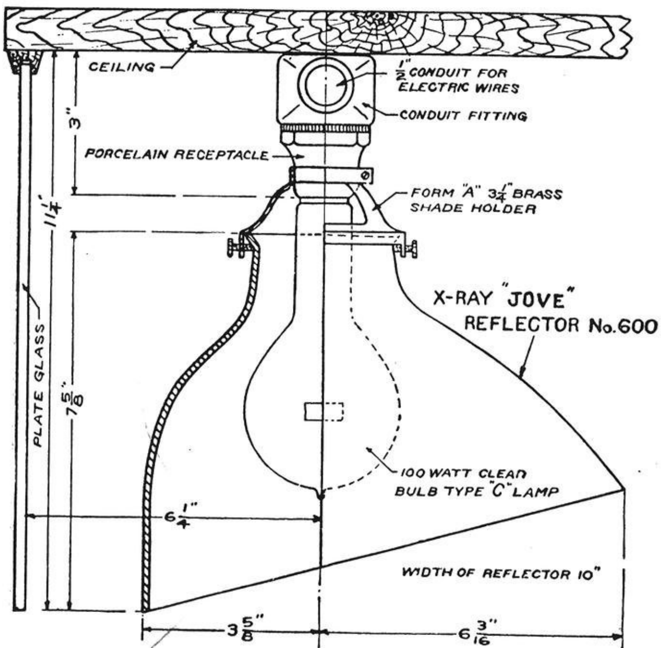

Fig. 2.—Contour of mirror reflector for 100 watt gas-filled tungsten lamp for average show windows.

purposes is equally as effective. The front surface or "nose" of the reflector is carried down sufficiently so that the lamp filament is concealed from view within the store, for most positions. Since the reflectors are usually installed considerably above the normal line of vision, this reflector affords good protection to the eyes of the customer, where the top of the background is clear glass.

So much for the plane perpendicular to the trim. In the plane parallel to the trim, the light distribution should preferably be symmetrical. Inasmuch as the lamps and reflectors in practice are closely spaced along the front of the window (from 18 to 36 in. centers) a fairly concentrating distribution in this plane is desirable in order to secure good diffusion and ample brightness. Curve B of Fig. 3 shows one-half of the symmetrical curve in the plane parallel to the glass, for the type of sil-

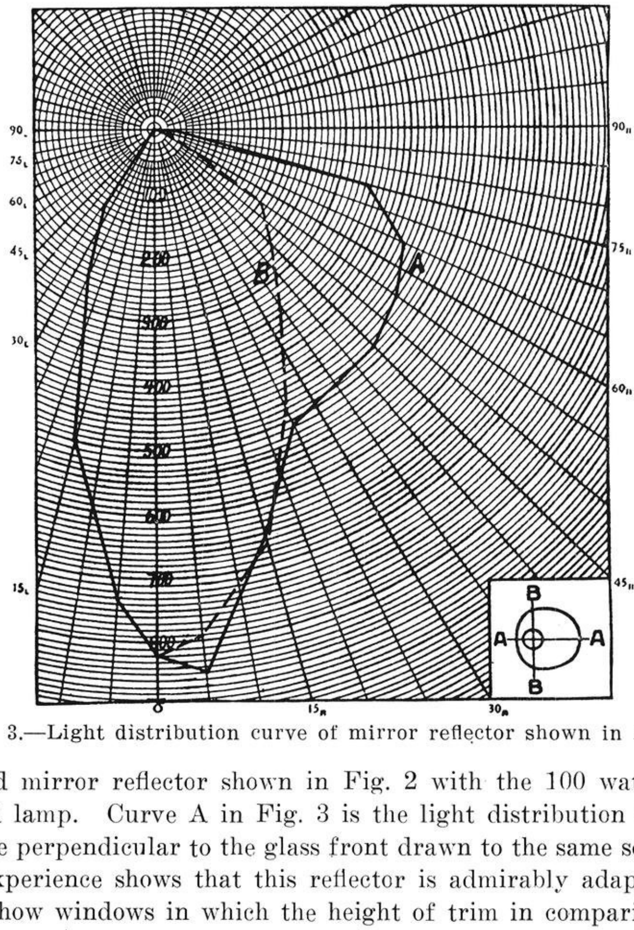

FIG. 3.—Light distribution curve of mirror reflector shown in Fig. 2.

vered mirror reflector shown in Fig. 2 with the 100 watt gas-filled lamp. Curve A in Fig. 3 is the light distribution in the plane perpendicular to the glass front drawn to the same scale.

Experience shows that this reflector is admirably adapted to all show windows in which the height of trim in comparison to the height of the window is fairly great, and which have a height varying from one to one and one-half times the depth. As will be noted, it cuts off as sharply at the window's edge as possible, without sacrificing intensity of illumination at the front of the window. Thus it will be seen that the maximum flux of the lamp is utilized in illuminating the trim. A dual system of very fine spiral and coarse radial corrugations eliminates filament images, streaks and stria. It is found with the concentrated coil filament very much finer corrugations are necessary to adequately break up the light rays. This dual system of corrugations secures results which for all practical purposes equal those secured

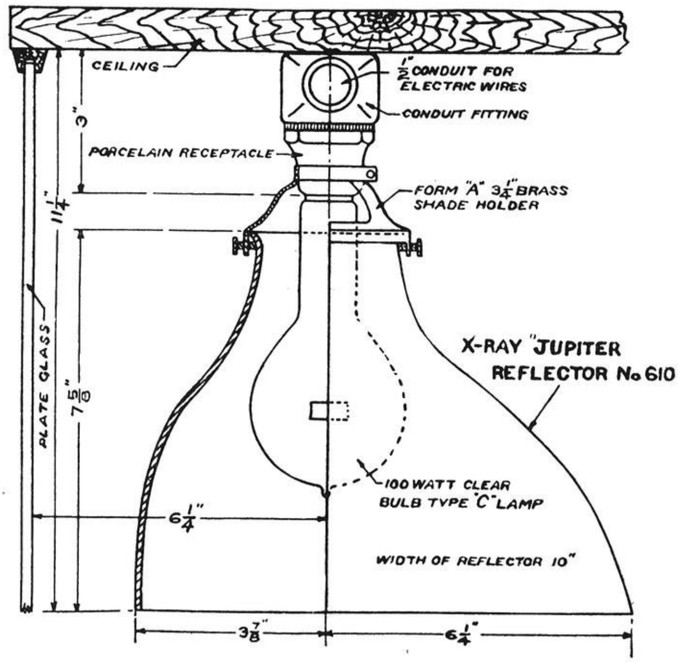

FIG. 4.—Contour of mirror reflector for 100 watt gas-filled tungsten lamp for high and shallow show-windows.

with an etched or roughed surface and at the same time the reflector obeys the law of regular reflection more closely and is more efficient. The 3¼″ neck supplies sufficient ventilation to keep all parts sufficiently cool.

For windows that are high and shallow (height twice the depth, and height of trim on background about equal to depth), another style of reflector has been developed. This reflector, Fig. 4, is more concentrating and confines its light to an angle —5° to +55°. This style of window, however, is less common now than the one previously described, but when encountered may be very satisfactorily illuminated by means of this reflector. Where the height of the window is more than twice the depth, one should not attempt to illuminate from the top. Under this condition the illumination is too nearly vertical in character. It is best to lower the lighting units, and since most such windows have a transom bar lower down, the units may be attached thereto.

THE MOMENT DIAGRAM AND ITS RELATION TO THE REINFORCEMENT IN A CONCRETE BEAM

S. C. HOLLISTER

In the past the design of reinforced concrete beams has involved some intricate problems relative to the proper placing of the steel reinforcement in the body of the beam. Extensive analytical methods have been resorted to, or a series of graphic constructions have been necessary, to determine the relative position of the component parts of the reinforcing material.

In the present paper it is proposed to set forth a method of placing the reinforcement for both bending and shearing resistance entirely from the moment diagram. To explain the method it is deemed necessary to review the principles upon which later operations are based, after which its application will be made to a specific design.

Consider a simple beam, uniformly loaded, as in Fig. 1. Let two transverse vertical sections, (1) and (2), be passed through the beam, at distances x_1 and x_2 from the left support. Then from mechanics it may be shown that

$$M_2 - M_1 = \frac{V_1 + V_2}{2} (x_2 - x_1)$$

Whence

$$V = \frac{M_2 - M_1}{s} \qquad (1)$$

in which V equals the average vertical shear on the portion of the beam $(x_2 - x_1) = s$.

Or,—The difference in moment between any two points along a beam is equal to the product of the average shear over the distance between the points, and that distance.

For loads concentrated at points along a beam this law is not strictly true, unless in each case the concentration occurs at a point midway between the transverse sections chosen; but in the case of "concentrated" loadings by beams cast against the girders in concrete construction, and even by loadings on slabs transmitted finally to the girder, the concentration may not be sharply defined, and there is no determinate law of shear variation over such a region. Moreover, as this discussion will show later, the distance s is relatively small where shear is large. Within the limits of actual conditions in reinforced concrete construction, therefore, the above statement may be considered very approximate for the beam loaded with concentrated loads.

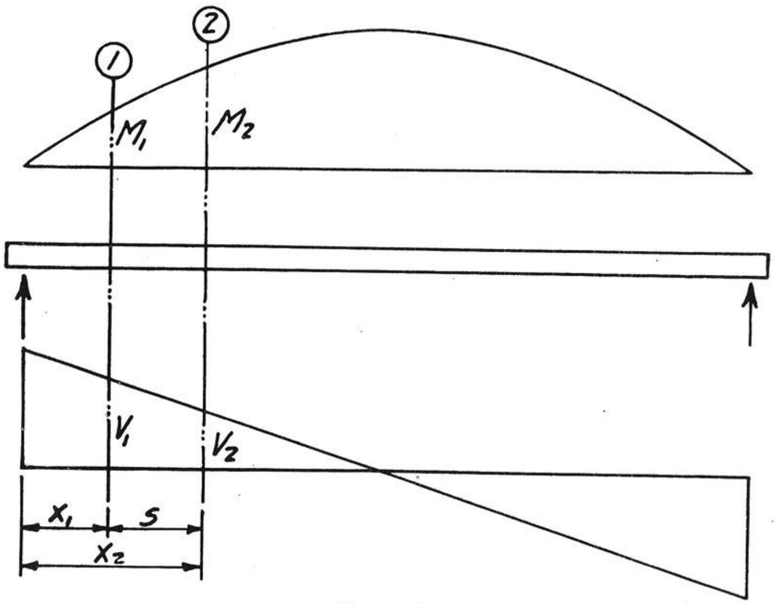

FIGURE 1.

From the discussions given in Turneaure and Maurer, Principles of Reinforced Concrete Construction, pp. 109 and 223, the amount of tensile stress required of a vertical stirrup to resist the shear stress is

$$\frac{Vs}{jd} \qquad (2)$$

in which V is the average vertical shear over the portion s of the beam. The idea of maximum shear intensity on a vertical section of the beam is retained in the above expression.

Since the tensile strength of the stirrup is relied upon to carry the above force, when s is the space between adjacent stirrups, the total strength of the stirrup, $a_s f_s$, would be equal to eq. (2), or

$$a_s f_s = \frac{Vs}{jd}$$

from which

$$V = \frac{a_s f_s jd}{s} \qquad (3)$$

which is the value of the average vertical shear over the portion *s* of the beam, to be resisted by the stirrup, in terms of the strength of the stirrup and certain dimensions of the beam.

In eq. (1) we have an expression of this average shear in terms of the change in moment along the portion *s;* so that by substituting in the above, we have at once,

$$M_z - M_1 = a_s f_s jd \qquad (4)$$

Let it be considered that the portion *s* be so chosen that section (1), Fig. (1), lies over the left abutment, at which point the moment M_1 is zero. (In continuous girder design section (1) may be considered as lying at a point of inflection, since the moment at that place is zero.) Let the moment increment from zero to M_2 be called M_i. Then from eq. (4),

$$M_i = a_s f_s jd \qquad (5)$$

It is to be noted that this moment increment represents the value of the adopted stirrup to resist the vertical component of diagonal tension over the portion *s* of the beam. Again, it should be clear that for any given stirrup of area a_s and of fiber stress f_s, the moment increment M_i varies directly with *jd*, a value dependent upon the characteristics of the beam; and that for a given beam and the given stirrup, the moment increment is a constant, irrespective of where the region *s* is chosen along the beam.

From values given in tests published in Principles of Reinforced Concrete Construction, it may be noted that the safe working shear stresses are about three times as great in a reinforced concrete beam as when the beam is not reinforced. We may say, therefore, that the concrete will be permitted to carry one-third of the shear, and the remainder will be cared for by the reinforcement. Eq. (5) then becomes

$$M_i = 1.5\, a_s f_s jd \quad \text{(Vertical Stirrups)} \qquad (6)$$

If the stirrup is inclined at an angle Θ to the horizontal then,

$$M_i = \frac{1.5\, a_s f_s jd}{\sin \Theta}$$

And when Θ = *45°*,

$$M_i = 2.1\, a_s f_s jd \quad \text{(Stirrups inclined 45°)} \qquad (7)$$

Eqs. (6) and (7) are the final working values of the resistance offered by a single stirrup in terms of an increment of moment.

The chart in Fig. (2) is a graph of the above equations when $j = 7/8$, a very common value in rectangular beam design. To use the chart, enter at the left with a given value of *d*, the depth of the beam; follow across horizontally to the line of the adopted stirrup area; then from this point move up to the fiber stress assigned to the stirrup; and finally passing to the right from this last point, the value of the moment increment for either vertical or inclined rods may be read.

Let us consider the portion of the beam shown in Fig. 3, loaded in such a manner as to produce the moment curve OA. It is desired to reinforce the portion shown with vertical stirrups, keeping in mind the principles just laid down. A certain stirrup has been adopted which for this particular beam gives the value of M_i from eq. (6) equal to the vertical distance shown in Fig. 3*a*. The first increment intercepts the portion *Om* of the curve; the second, *mn*, and so on. Let one of these intercepts, as *mn*, be projected onto the beam, thereby defining an area ABCD on the diagram of the beam. From the preceding discussion this area is the portion of the beam in which the adopted stirrup will exactly carry the shear. The length *s* of the portion is seen to vary as the shear varies along the beam. Since the stirrup is required to carry the shear for this portion of the beam it will be placed through the center of the portion. Likewise, each other portion of the beam defined by the projection of the intercept of M_i will have a stirrup placed at its center.

To eliminate the feature of dividing each portion of the beam, the following method is suggested. Lay off, as the first value,

$\frac{1}{2}M_i$ (Fig. 3*b*). Let all other values equal M_i, as before. These increments have m^1, n^1, and so forth, for points of intersection on the moment curve. Let these points be projected onto the beam. Each projection will thus determine the posi-

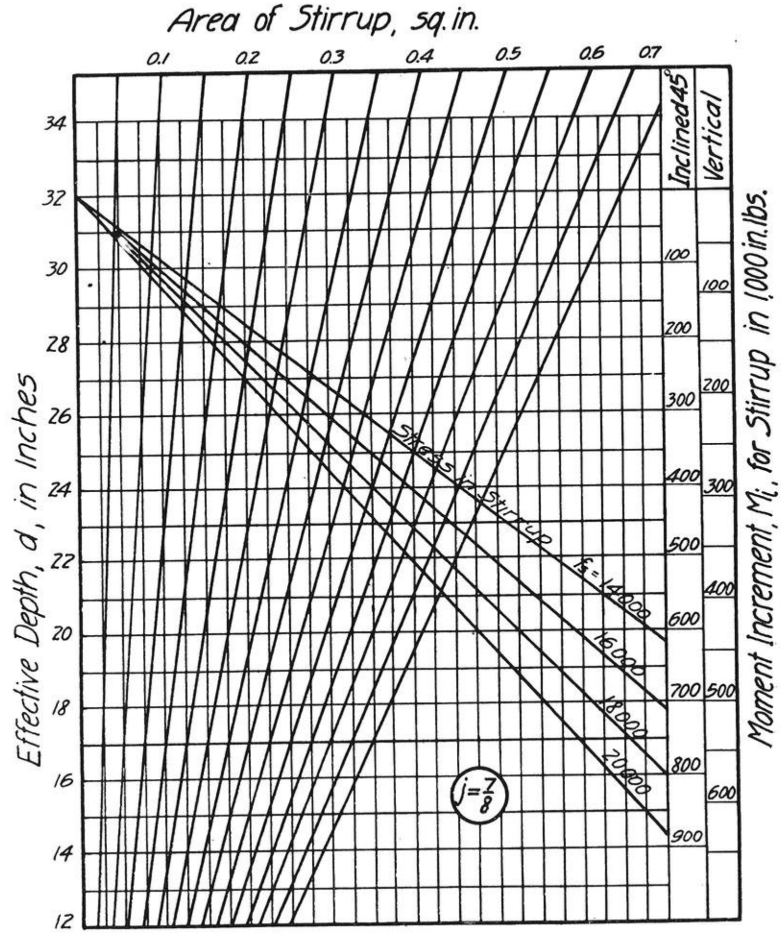

FIGURE 2.

tion of the stirrup. This gives very closely the same results as before, since in this case each increment has been bisected, rather than bisecting the projection of the intercept on the curve. However, if the increment is large, as is sometimes the case with bent-up bars, it is likely to subtend a portion of great curvature, in which case the original method is advised. The second method will be found within practical limits for the spacing of vertical stirrups.

The design of a T-beam will now be followed through in detail. The span will be taken as 24 ft. between centers of supports. The thickness of the flange will be assumed to be limited by a 10-in. floor, and the total depth to approximately 3 ft. The following working stresses will govern the design: $f_s = 16{,}000$ lb/in.^{2}; $f_c = 650$ lb/in.^{2}; $u = 80$ lb/in.^{2} (at the supports 50 % excess allowed, or 120 lb/in.^{2}); $v = 35$ lb/in.^{2} for concrete and

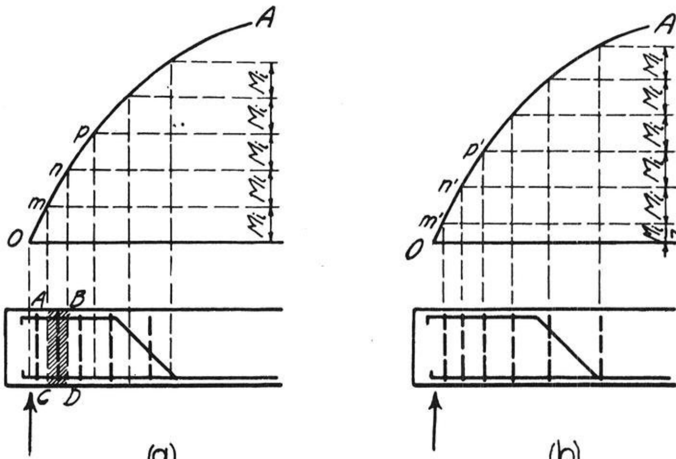

FIGURE 3.

105 lb/in.^{2} for reinforced concrete. Attention is called to the ratio ⅓ of the two shear values just given. This is in accordance with the development of eqs. (6) and (7). The total load on the beam will be taken as 4,000 lb/ft.

The maximum moment is found to be 3,460,000 in. lbs., and the shear at the support, 48,000 lbs. The required web area is 458 in.^{2} or 33 in. deep and 14 in. wide. From Plate X, Turneaure and Maurer, $b = 31$ in., and $jd = 29.2$ in. A_s is found to be 7.4 in.^{2} Eight rods 1 in. square will be used. The value in moment of one pair of rods is computed to be 932,000 in. lbs. The arrangement of the rods in cross-section is shown in Fig. 4*c*. The width of the web was changed to 15 in. for clearance between rods. The length of rod necessary to develop its tensile strength in bond is 50 in. At the support four rods are necessary to carry the bond stress.

With the above computations available, the placing of the steel in the beam may be done. Fig. 4*a* shows the bending moment diagram. The resisting moment of each pair of rods is plotted, resulting in the stepped diagram along the exterior of the moment curve. The point of contact of the line with the curve indicates a point of zero stress in the rods corresponding to the zone immediately above the point. This pair of rods may be bent up at this point therefore, since they are no longer needed to resist moment. It is noted that the four lower rods are required to continue to the end of the beam without being bent up; hence only the upper rods will be bent.

It is proposed to make two arrangements of the steel,—one in which the bent-up rods are intended to carry a portion of the shear (right side of Fig. 4*b*), and the other in which the stirrups are designed to carry all the shear (left side of Fig. 4*b*). The second case, that of all shear being carried by the stirrups, will be treated first. Since it happened that in this T-beam the value of j is $\frac{7}{8}$, it will be permissible to use the chart in Fig. 2. In choosing a value of a_s, the area of the stirrup, a value should be so chosen that the last useful spacing, projected from the last full value of M_i at the vertex of the moment curve, does not exceed in general $\frac{3}{4}d$, and never more than d. It is possible to estimate by inspection a value of M_i that will give this final spacing. Entering at the right of Fig. 2 with this estimated value, then over to the line of fiber stress, and next down to the intersection with a horizontal line from the depth d, gives a tentative value of a_s which may be adjusted slightly to meet the commercial dimensions of the steel. With this corrected value of a_s, and passing through the chart from the left, a final value of M_i may be obtained very close to the desired value. The adopted stirrup is shown in Fig. 4*c*.

Following the suggestions relative to Fig. 3*b*, half of the value of M_i as determined above is first laid off; then the full value is laid off repeatedly until the vertex of the moment curve is reached. The intercepts on the moment curve, when projected onto the beam, determine the positions of the vertical stirrups.

The numerical value for the $\frac{3}{8}$ in. round stirrup, in terms of

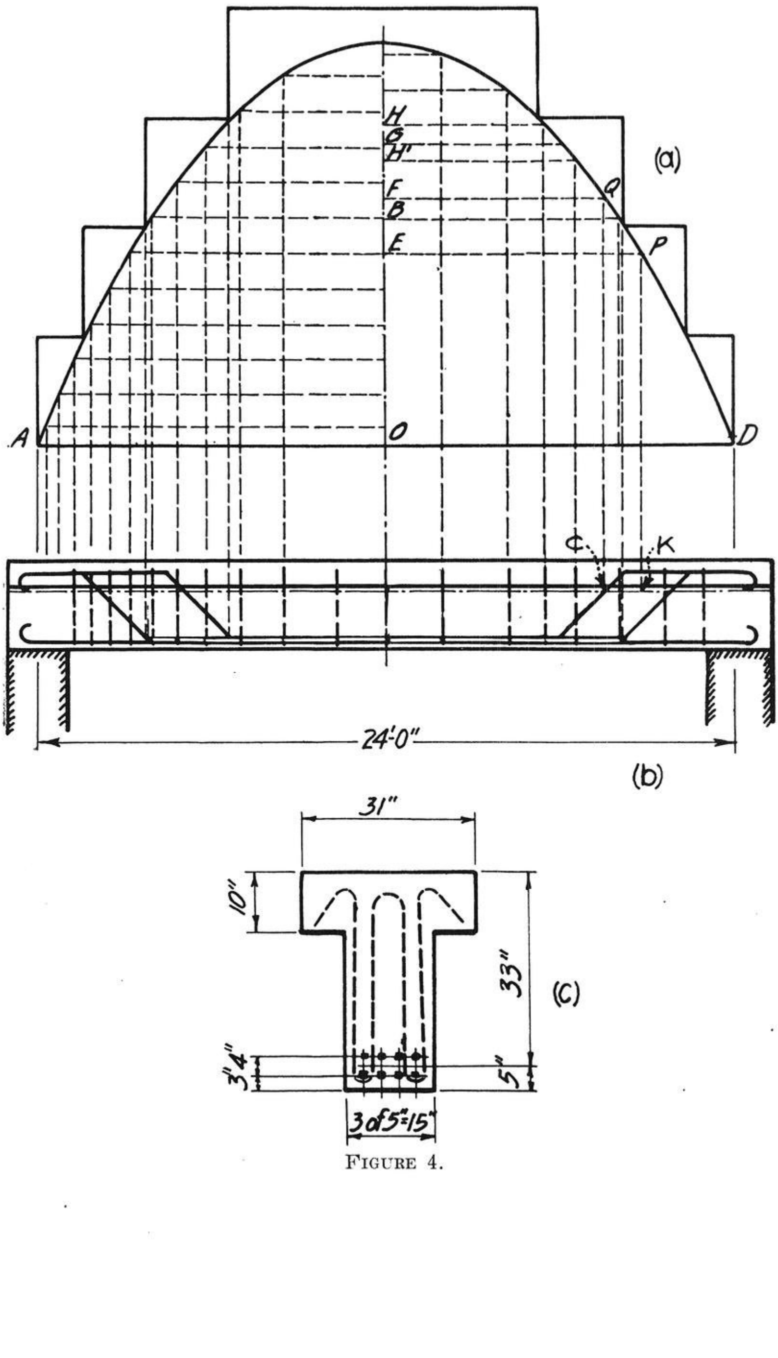

FIGURE 4.

the moment increment, is 300,000 in. lbs. They develop sufficient bond to cause a tensile stress of 12,500 lb/in.^{2}; and in addition they are hooked and bent to develop the full stress. At the bottom they pass below the horizontal steel.

In the case where the bent-up rods carry a part of the shear, investigation as to their strength in shear resistance must first be made before the point of bending can finally be fixed. Considering a pair of these rods as an inclined stirrup, a moment increment may be determined for the pair from eq. (7). This was found to be 1,960,000 in. lbs. This value is laid off vertically, as OB, Fig. 4*b*. The distance *s* corresponding to the pair of rods is much greater than *d*. The pair is then excessively strong to take the shear; and since the spacing given for bending the rods is also greater than *d,* the second pair of rods will be turned up as shown from the bending diagram while the first pair will be bent up at an arbitrary distance *jd* toward the center from the bending point of the second pair. The arrangement is shown in the right half of Fig. 4*b*.

Point K represents a point midway between the intersections of the two pairs of bent-up rods with the neutral plane. The projection of K upon the moment curve is P, thereby determining the chord EP. Point C is the intersection of the first bent-up pair with the neutral plane, and its projection on the moment curve is Q, thus establishing FQ. EF, therefore, is half of the actual increment ascribed to the first bent-up pair, on the basis of spacing. EF is then laid off again, as FG, thus completing the increment EG. The portion of the curve from O to G, therefore, is cared for by the bent-up rods. Since OB is the permissible value for one pair, it is seen that they are amply strong to carry the shear, and that their placing was determined by the approximate maximum spacing.

Beginning with G, the stirrup increments are laid off, the first being half value, (GH), as previously explained. The intersections with these and the moment curve determine the positions of stirrups through the region between C and the center of the beam. It is noted that the stirrup resulting from H is past the point of bending up the first pair of rods. The space to C is too great in the light of good practice, even though it may be very close to *d*. Point H^1 is therefore set, with GH = GH^1, and an extra stirrup placed Between this stirrup and the support arbitrary stirrups are placed at approximately ¾d apart, for the purpose of supporting the bent rods during construction.

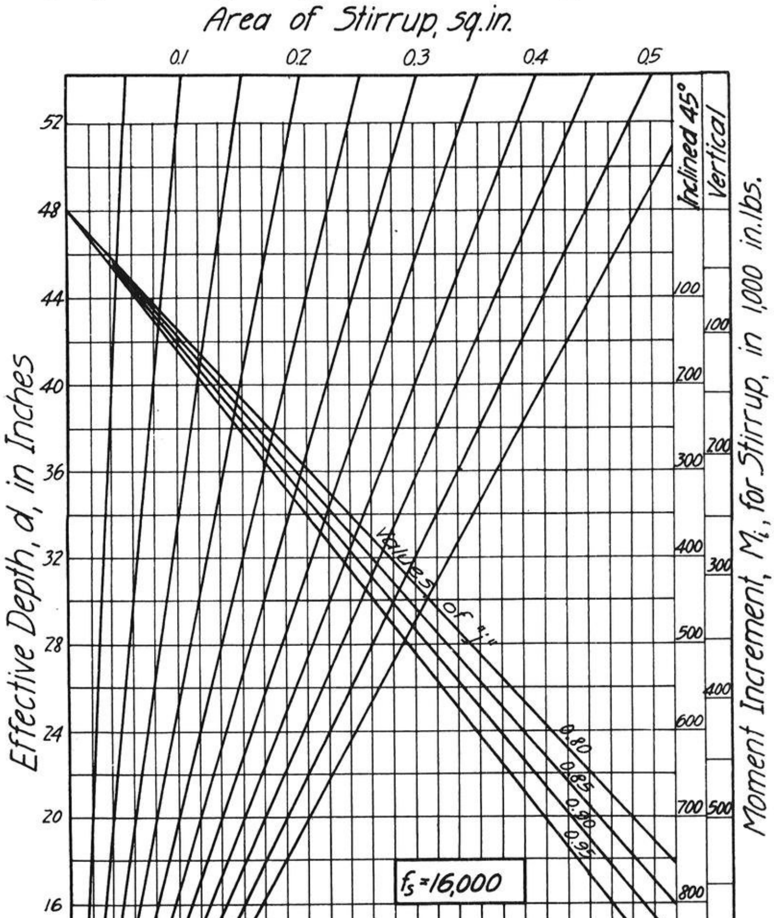

FIGURE 5.

The rods turned up are carried 50 in. beyond, to develop the required bond. In addition they are hooked at the ends.

The chart in Fig. 5 shows the solution of eqs. (6) and (7) when j is variable and $f_s = 16{,}000$ lb/in.² A set of similar charts may be made up, each with a different fiber stress. Such a set will apply to both rectangular and T-beams. Fig. 2 applies to nearly all forms of rectangular beams since j varies so slightly; but it is not applicable to T-beams except when j is $7/8$, as was the case in the preceding problem. For T-beams j varies from .82 to .97 and therefore requires a chart that takes this change into account.

A simple method of constructing the parabola when the middle ordinate is known is not out of place in this article. Let AG, Fig. 6, represent the base of the parabola, with a middle ordinate of 4.5 at D. Divide the base into any desired number of equal parts, as for instance, six. Number these points from

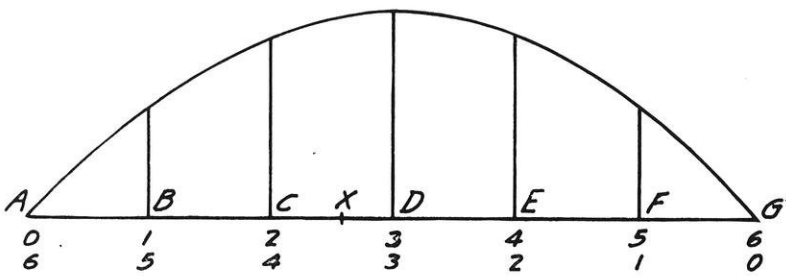

FIGURE 6.

each end beginning with zero. Divide the middle ordinate by the product of the numbers at that point, as $4.5/(3 \times 3)$ or 0.5. This constant, if multiplied by the product of the pair of numbers at any point gives the ordinate at that point. For example the ordinate at C is $2 \times 4 \times 0.5 = 4.0$. If an ordinate is desired at a point between the equal divisions, as X, the fractional part of the division may be expressed for the point from each way. At X the distance from A is 2.6 units, and from G, 3.4 units. The ordinate at X is $2.6 \times 3.4 \times 0.5 = 4.42$. If the middle ordinate does not fall at an even division, as would be the case if an odd number of units were used, the fractional values for the mid-point would be used the same as the full values in the above case.

HISTORICAL INTERPRETATION OF THE WISCONSIN LAW FOR THE REGULATION OF PUBLIC UTILITIES

R. C. DISQUE
Ass't Professor Elec. Engr.

In 1907 a remarkable law was enacted by the Legislature of Wisconsin. By its provisions the power of regulating the gas, the electric and telephone utilities of the state was delivered into the hands of a commission composed of three men appointed by the governor. Henceforth any person or persons supplying gas, electricity or water, or furnishing means for telephone communication within the state would practically relinquish all control over the important questions of business policy and even over the destiny of the business itself. The law required the Commission to appraise the physical property of every public utility in the state; to determine the capitalization of those companies; to fix the rate of return on the capitalization determined; to prescribe and enforce uniform accounting; to enforce the establishment of depreciation accounts; and to set the standards of service and enforce these standards by service inspection. Stock and bond issues were regulated under an earlier law.

But this was not all. The law further provided for the purchase of the plant by the city without the consent of the company; empowered the Commission to set the price and laid down in detail the course of procedure for such purchase. The old method of granting term franchises to public utility companies was abandoned in favor of the so-called indeterminate permit, which allowed the utility to do business under strict regulation until the community should see fit to take over the plant. Moreover, provision was made for allowing a company holding a term franchise to give it up and receive in its place an indeterminate permit; but the acceptance of the indeterminate permit carried with it the agreement that the company would sell out to the municipality under terms similar to those laid down for granting an indeterminate permit in the first instance. In return for submitting to these strict ordinances the companies were assured the assistance of the state in securing a fair return on their true capitalization and protection against the annoyances of municipal regulation. Another significant feature of the law was the prohibition of a second utility where one already existed. Since the ineffectiveness of competition was the fundamental premise on which the law was based, the toleration of competition was felt to be wholly incompatible with the theory of regulation as applied in the law. [Since a second utility was not to be allowed to enter a field already served by a similar utility without the approval of the Commission and since there could in the very nature of the case be no call for a second utility where the first were strictly regulated, it is fair to conclude that competition in the gas and electric business was repudiated as an efficient means of furnishing gas and electric service.] Exception was made in the case of the telephone business, for it was not considered expedient to legislate the independent telephone movement out of existence.

This was the most advanced law in existence on this subject. It was received with favor by the people of the state: the companies themselves, with few exceptions, were in favor of it; and disinterested experts vied with each other in praising it. In practice it has so far more than realized the hopes of its sponsors and it has become a model for legislation on this subject in more than half the United States. Surely a law so significant merits a full measure of sincere study. It will be my purpose to trace the development of the regulation principle from its beginnings to its mature form, represented by the Wisconsin law, and to attempt to show the significance of the law in that development.

Strikingly new as it may seem, it did not spring into existence in a minute. The forces of conservatism in our political life are far too strong to permit such an event. While the law represents a step in advance, it is by no means a sudden bound in the steady advance of our political institutions. We may be sure that it has a past and a long one; and, if it has come to stay, we may be equally sure that it points with significance to a future development.

The germ of the theory that lies at the basis of all regulation of this kind is found in a legal tract published in England in 1787. This tract was written by Lord Hale and preserved through the good offices of a friend to whom the author had entrusted the manuscript and who published it at a financial loss to himself. It was entitled "de Portibus Maris," and its object was to explain the time-honored common law practice of England in matters pertaining to navigation. The significant feature of the essay is that portion which contains a denial of the right to charge excessive wharfage. It is as follows:

"If the king or subject have a public wharf, unto which all persons that come to that port must come and unlade their goods as for the purpose, because they are the wharfs only licensed by the queen according to the statute of I Eliz. Cap. II, or because there is no other wharf in that port, as it may fall out where a port is newly erected, in that case there cannot be taken arbitrary and excessive duties for cranage, wharfage, pierage, etc., neither can they be enhanced to an immoderate rate, but the duties must be reasonable and moderate though settled by the king's license or charter. For now the wharf and crane and other conveniences are affected with a public interest and they cease to be *jus privati* only; as if a man set out a street in new building on his own land, it is now no longer private interest, but it is affected with a public interest.

"But in that case the king may limit by his charter, and license him to take reasonable tolls, though it be a new port or wharf, and made public; because he is to be at the charge to maintain and repair it, and find those conveniences that are fit for it, as cranes and weights."

It is at once apparent that two principles are set forth in this utterance, viz: (1) Denial of the right to charge unreasonably for service affected with a public interest; and (2) Recognition of the inherent right to collect for service of this kind such fees as will yield the owner a return commensurate with the trouble and expense of maintaining the instruments of service in good order.

From the point of view of expediency and the public good this proposition seems simple enough. That an individual who owns private property which must necessarily be used by the public should be able to charge whatever he chooses for such use is obviously intolerable. On the basis of the common law as set forth in "de Portibus Maris" the English courts were not slow to regulate more or less drastically all private business enterprises in which the public happened at any particular time to have an interest. Quite consistently, the courts added a new restriction, namely, that those engaged in certain callings be compelled to serve any and all persons at a reasonable rate, when the price for such service was tendered. Thus in 1683 in Jackson v. Rogers it was held that action was maintainable against a smith for "refusing to shoe my horse or an innkeeper for refusing to accommodate me as a guest." Again in 1710 in Gisburne v. Hurst it was decided that any man undertaking for hire to carry goods of all persons indifferently was engaged in a business affected with a public interest and was subject to the restraints of the common law.

But judicial procedure in regulation of business affected with a public business was evidently unsatisfactory even in the sixteenth century. The practice of waiting for the court to decide whether or not each particular case involved the public interest left the whole question always an open one; no one engaged in business could know in advance his duties, or his rights. For this reason statutory regulation soon began to generalize on this question of the public interest, to define business affected with a public interest and to regulate certain practices pertaining to that sort of business.

In 1533 there was passed a law regulating the price of certain kinds of food; in 1534 one for regulating the price of books; in 1543 one for regulating the price of beer and beer barrels; and in 1555 one for regulating the charges and conduct of the business of ferrymen on the Thames. In 1690 the price of coal was regulated, and in 1691 the rates of charge of common carriers. Indeed, the sole criterion for regulation seemed to be the necessity therefor; as soon as it became evident that a necessity of life was in danger of rising to an undue price it was considered a fit subject for regulation. In other words, every commodity necessary in life could be construed to be clothed with a public interest and be subjected to the two cardinal principles of the common law, as stated above.

The English precedents of regulating on the mere score of necessity were diligently followed in the American colonies. In 1635 Plymouth colony regulated the wages of workingmen, for labor was in great demand; in 1642 blacksmiths were compelled to repair weapons at reasonable rates, for at that time it was important that every one be adequately armed. For obvious reasons a law was passed in 1638 for regulating ferry and mill tolls and for preventing corners in the necessities of life.

It is not so clear why the price of beer was regulated in 1636, but it was probably because it was thought to need regulation on the score of public necessity. Again, in 1655 Massachusetts gave its selectmen the power to regulate wages; in 1646 to regulate the size and price of loaves of bread; and in 1671 we find a statute regulating the price of rum. As soon as commodities seemed to need regulation they were regulated, no matter how private the business of furnishing them might seem to be.

Necessity was the mother of regulation: we seek in vain for any other basis or excuse.

Our forefathers exhibited few scruples in encroaching upon private interest when the public interest seemed to them to be threatened. In the nature of things competition, that expensive recipe for all economic ills, could not be very strong in those early days. But the absence of competition made regulation necessary, affording a proof of the general rule that the state stood ready to regulate if the natural order of economic events failed to protect the public interest.

In the absence of statutory regulations, the courts have always been ready to enforce the common law duties of business affected with a public interest. Such persons as innkeepers, hack drivers, ferrymen, and, later, railroad companies, have always been subject to the old cumbersome process of judicial regulation. The term common carrier was invented to characterize those kinds of businesses that obviously required no statutory definition. Common carriers were first to be regulated, not on account of any specific property of carriage but because the business of carriage was the first to be monopolized and thus the first to need regulation.

We search these early cases in vain for any reason but necessity for governmental regulation. That monopoly of a necessity of life is the mother of regulation is very well shown by the history of the business of furnishing gas and electric service. Gas and electricity were not subject to regulation until they become recognized necessities of life. In the case of Huddeson vs. Hazlewood, decided in 1859 by the Court of Common Pleas of Great Britain, the Chief Justice (Cockburn) in the decision of the court said: "We cannot imply a contract from the accidental circumstances of this company having a monopoly of the supply of gas to a neighborhood. I see nothing whatever to bind either the one party to take or the other to furnish the supply any longer than their convenience, or their caprice, may induce them to take or to supply."

Early American decisions in gas cases hold the same doctrine. The most significant is Commcnwealth vs. Lowell, a Massachusetts case in which it was held that "The ground of this contention is that the defendants are a *quasi*-public corporation and come within the principle on whch turnpike, railroad, canal and other like corporations, established for the convenience and accommodation of the public . . . But we fail to see that the defendants can be properly regarded as a corporation of this character. No public duty is imposed upon them, nor are they charged with any public trust. They are authorized to make and distribute gas for their own profit and gain only. They are not bound to sell and dispose of it to anyone, either for public or private consumption. It is entirely at their own option whether they will exercise their corporate rights and privileges at all: if they undertake to manufacture and dispose of gas, the extent to which they shall carry on the business is left to their own election." Even more unequivocal is the language of McCune vs. Norwich City Gas Co., a Connecticut case decided in 1862: "The manufacture and sale of gas is a business which may be prosecuted or discontinued at the will of the party engaged in it. The relations between the maker and the consumer originate in the contract between them and their respective rights and obligations are controlled entirely by the stipulations of such contracts, and as (where no contract prohibits) the one may refuse to take the article at his pleasure, so may the other refuse to supply it. We discover no reason for subjecting the maker of gas to duties or liabilities beyond those to which manufacturers and venders of other commodities are subjected by rules of law." The same doctrine is held in a contemporaneous New Jersey case, Paterson Gas Light Co. vs. Brady (27 N. J. L. 248). But the time came when gas became a necessity; the business of furnishing it was then, and not until then, held to be clothed with a public interest and no one today ventures to define it as a strictly private business.

The right of the state to define and declare a business to be affected with a public interest, and so justify regulation, was seriously tested and unmistakably affirmed when the Supreme Court of the United Satates was called upon to decide the famous four Granger Cases in 1876. The first of these, Munn v. Illinois (94 U. S. 113), was epoch making in its importance. It involved the question whether the State of Illinois had the constitutional right to regulate prices for storing grain in elevators. The legislature had enacted a law prescribing such prices. The firm of Munn and Scott, owning and operating warehouses for storing and shipping grain in Chicago, refused to observe the provisions of the statute. They were prosecuted, found guilty and fined. Appeal was taken to the Supreme Court of the state and to that of the United States, where the defendants attacked the right of the state to regulate such charges, on the ground that the statute violated the portion of the Constitution that guarantees the inviolability of private property and forbids the taking of private property for public use without due process of law. The Supreme Court in affirming the judgment of the lower courts laid down in unmistakable terms the principles upon which the regulatory powers of the state rest.

By the decision in this case, new life was breathed into the common law doctrine announced by Lord Hale almost a hundred years before. The court said:

"This brings us to inquire as to the principles upon which this power of regulation rests, in order that we may determine what is within and what without its operative effect. Looking, then, to the common law, from whence came the right which the Constitution protects, we find that when private property is affected with a public interest, it ceases to be *jus privati* only. This was said by Lord Chief Justice Hale more than two hundred years ago, in his treatise De Portibus Maris, 1 Harg. Law Tracts, 78, and has been accepted without objection as an essential element in the law of property ever since. Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large. When, therefore, one devotes his property to a use in which the public has an interest, he, in effect, grants to the public an interest in that use, and must submit to be controlled by the public for the common good, to the extent of the interest he has thus created. He may withdraw his grant by discontinuing the use; but, so long as he maintains the use, he must submit to the control."

More significant, however, is the principle upon which is based the conclusion that the warehouses were clothed with a public interest.

"In this connection it must also be borne in mind that, although in 1874 there were in Chicago fourteen warehouses adapted to this particular business, and owned by about thirty persons, nine business firms controlled them, and that the prices charged and received for storage were such as have been from year to year agreed upon and established by the different elevators or warehouses in the city of Chicago, and which rates have been annually published in one or more newspapers printed in said city, in the month of January in each year, as the established rates for the year then next ensuing such publication. Thus it is apparent that all the elevating facilities through which these vast productions of seven or eight great States of the West must pass on the way to four or five of the states on the seashore may be a virtual monopoly.

"Under such circumstances it is difficult to see why, if the common carrier, or the miller, or the ferryman, or the innkeeper, or the wharfinger, or the baker, or the cartman, or the hackney-coachman, pursues a public employment and exercises a sort of public office, these plaintiffs in error do not. They stand, to use the language of their counsel, in the very gateway of commerce, and take toll from all who pass. Their business most certainly tends to a common charge, and it is become a thing of public interest and use. Every bushel of grain for its passage pays a toll, which is a common charge, and, therefore, according to Lord Hale, every such warehouseman ought to be under public obligation, viz., that he * * * take but reasonable toll."

In effect, this decision declares that any business may at any time be held to be affected with a public interest and so become subject to regulation, when it appears that necessity for such regulation exists. Every private property that represents a step in the process of bringing the necessities of life to the consumer (and what business does not?) therefore exists unharrassed only by sufferance; it may be brought under regulation at any time at the discretion of the legislature.

Lest we suspect that the state's power of regulation rests on the existence of a franchise or the possession of special privileges, let us examine the decision in the case of People v. Budd (117 N. Y. 1), a New York case decided on the doctrine of the Munn case. Here the question again went to the constitutionality of a law fixing the price for handling grain. After citing with approval the decision of the Munn case, the Court says: "The question is whether the power of the legislature to regulate charges for the use of property, and the rendition of services connected with it, depend in every case upon the circumstances that the owner of the property has a legal monopoly or privilege to use the property for the particular purpose, or has some special protection from the government, or some special benefit in the prosecution of his business.

"Can it be said, in view of the exceptional circumstances, that the business of elevating grain is not 'affected with a public interest' within the language ofLord Hale, or that the case does not fall within the principle which permits the legislature to regulate the business of common carriers, ferrymen, innkeepers, hackmen, and the interest on the use of money? It seems to us speculative, if not fanciful, reasons have been assigned to account for the right of legislative regulation in these and other cases. It is said that the right to regulate the charges of hackmen springs from the fact that they are assigned stands in the public streets; that the legislature may regulate the toll on ferries because the right to establish a ferry is a franchise, and therefore the business is subject to regulation; that the right to regulate wharfage rested upon the permission of the sovereign to extend wharves into the beds of navigable sreams, the title to which was in the sovereign; that the right to regulate the interest on the use of money sprung from the fact that taking interest was originally illegal at common law, and that where the right was granted by statute it was taken subject to regulation by law. The plain reason, we think, why the charges of hackmen and ferrymen were made subject to public regulations is that they were common carriers. The reason assigned for the right to regulate wharfage in England overlooks the fact that the title to the beds of navigable streams was formerly vested in a subject, and was his private property, subject to certain public rights, as the right of navigation, and no distinction as to the power of public regulation is suggested in the ancient books between wharves built upon the beds of navigable waters, the title to which was in the sovereign, and the wharves erected upon navigable streams, the beds of which belonged to a subject. The obligation of the owner of the only wharf in a newly erected port to charge only reasonable wharfage is placed by Lord Hale on the ground of a virtual, as distinguished from a legal, monopoly. The reason assigned for the right to regulate interest takes no account of the fact that the prohibition by the ancient common law to take interest at all was a regulation, and this manifestly did not rest upon any benefit conferred on the lenders of money. It was a regulation springing from a supposed public interest, and was peculiarly oppressive on a certain class. A law prohibiting the taking of interest on the use of money would now be deemed a violation of the right of property. But the material point is that the prohibition, as well as the regulation, of interest, was based upon public policy, and the present conceded right of regulation does not have its foundation in any grant or privilege conferred by the sovereign. The attempts to place the right of public regulation in these cases upon the ground of special privilege conferred by the public on those affected cannot, we think, be supported. The underlying principle is that business of certain kinds holds such a peculiar relation to the public interests that there is superinduced upon it the right of public regulation. We rest the power of the legislature to control and regulate elevator charges on the nature and extent of the business, the existence of a virtual monopoly, the benefit derived from the canal, creating the business and making it possible, the interest to trade and commerce, the relation of the business to the prosperity and welfare of the state, and the practice of legislation in analogous cases. These circumstances collectively create an exceptional case, and justify legislative regulation."

These cases show that whenever public interest seems to require regulation, the courts will regulate or will permit the legislature to do so, even in the absence of privileges or franchises.

They are not judicial freaks but the results of hundreds of years of development and the fruits of the study of eminent jurists. They have been reaffirmed again and again as settled principles of the law.

By precedent and tradition the functions of the legislature and the courts have been fairly well differentiated. While the courts have not themselves relinquished the right they have recognized the right of the legislature to define public business and have themselves laid down certain definite rights and duties of such business. The courts have obligated all those engaged in a business affected with a public interest to serve all who apply, to provide adequate facilitites for service, to demand only reasonable compensation, and to refrain from discrimination. Each of these duties is limited by reasonableness, a term that occurs repeatedly in decisions on those questions. Whether or not the circumstances attending the fulfillment of these duties are reasonable is for the court to decide in each specific case; the courts will not attempt to define exactly what is reasonable but will decide in a given case whether or not the thing in question is reasonable. For example, in the matter of rates of charge for service, the courts will decide in each case whether or not a certain rate is reasonable, but will not attempt to fix a reasonable rate. The fixing of the rate was primarily a legislative function.

We find in this reluctance of the courts to set definite standards one very good reason why the subject of standards of service and rates has been so utterly confused. A company sets a rate; the court declares it too high. Without adequate investigation some governmental body like a common council, utterly incompetent to decide, demands service at a lower rate; the courts decide that this is too low. Since there is no way to determine in advance what was reasonable, there is only one thing for the company to do, namely, fix the rate so high as to insure satisfactory return, and take a chance in court; on the other hand there remains for the council only one thing to do, namely, fix the rate so low as to insure cheap service, and take its chance in court. If perchance the rate fixed by the one or the other came very near being reasonable the court faced a difficult problem, no less than that of receiving a course of instruction in the scientific and commercial technique of the business, at the expense of the consumer, of course. If the case went to higher courts each of these higher courts received a similar course of instruction. When this whole expensive process was finished there issued nothing of permanent value to guide in making future decisions.

Moreover, the bare application of common law doctrines as followed by the courts left room for certain conditions intolerable in the public service. It has been held, for instance, in the case of the Clinton Electric Light, Heat and Power Co. v. Snell (95 Ill. App. 552), that an electric light company is at liberty to grant favors to certain parties and withhold them from others, provided only that it deals reasonably with the others. It was held not to be discrimination to charge one person less than another provided that the rate in the latter case is reasonable. While this may not lead to seriously disturbing results in certain classes of business, it would be intolerable in the gas and electric business.

There could be only one result. Inevitably, some means had to be found for arriving at a fixed standard and putting an end to the expensive game of court procedure. The duty of setting definite standards was clearly a legislative function; and so the legislatures set up fixed standards of service. The determination of these standards was a comparatively easy task; but when the rate question pressed for solution the legislatures found it impossible to solve it directly. The attempts to fix standards and prices without sufficient data were little better than the former feeble attempts on the part of municipal councils. In 1885 the legislature of the state of Massachusetts took the first step toward a solution of the problem that had been forced upon the legislative branch of the government by forces beyond its control. The legislature created a Board of Gas Commissioners to which it delegated the duty of ascertaining what standards of quality and price could be reasonably demanded and of enforcing these standards. The board was empowered to order changes in service or rates on complaint in definite cases, but could not fix general standards or prices. This power remained in the hands of the legislature. The board was charged with the duty of investigating and recommending, but no more than that. As time went on the plan of gathering material for a sound determination of the problems proved so satisfactory that the powers of the board were amplified. By the year 1897 these powers had grown to considerable proportions, including, in addition to those given in the original law, the power to prescribe uniform accounting, to regulate stocks and bonds and to inspect all meters in both the gas and electric businesses.

The Massachusetts laws had accomplised much in reducing to a sound basis the duties which the companies owed the public under the common law, but not much in doing the same for their rights under the common law. It will be remembered that at common law the utility is required to furnish adequate service, service without discrimination and service to all, while its rights included that of receiving fair compensation for its service. The only section of the Massachusetts law that might be construed to take into account the welfare of the utility is that which made it necessary to show a certificate of authority from the municipal authorities before a utility could start business. But even this seems to be drawn rather to protect the public against imposition on the part of the utility than to protect the company against competition.

The same may be said of the New York law of 1907. This law, like that of Massachusetts, gave the commissions the power to supervise the utility business, but approached the problem in the same one-sided spirit. The law seemed to be based on the assumption that the utility companies were amply able to protect their common law rights but that the need was for means to hold them to their common law duties. The law makes constant reference to what shall be unlawful practice on the part of the utility and empowers the commissions to prevent such unlawful practices. It says, "charges for service shall be just and reasonable and not more than allowed by order of the commission," and the commission shall have the power to "fix a maximum price of gas or electricity, or may order such improvement in the manufacture or supply." The assumption seemed to be that only those cases would come before the commission which involved excessive charges or inadequate service. Under a strict interpretation of the law it is difficult to see how any other kind of case could come before the commission. It is true that the law allowed the commission to use any facts that seemed relevant in arriving at a rate; but no provision was made for valuation and it is doubtful whether the law considered the investment as an important element in the question of rate making. Of course no rate that did not take into account the value of the property could hope to stand the test of judicial review, and yet valuation was not expressly provided for.

The Wisconsin law, passed in the same year, 1907, was the first significant attempt to treat the problem of legislative regulation as a two-sided question. It proceeds on the assumption that if the state has a right to regulate at all it has a right to regulate effectively and for the benefit of all concerned. In order to arrive at a sound basis for rate making, the law requires the commission to appraise the property of every public service company in the state; in order to gather the necessary data for intelligent treatment of the problem the commission must establish and enforce uniform accounting; in order to insure satisfactory service it must set standards for such service; in order to prevent abuses it must prevent free service and discriminatory rates; in order to prevent judicial embarrassment such as has stultified many administrative commissions, the law laid down definitely the form of procedure for court review and prohibited the hearing of any evidence not first presented to the commission.

But these means simply insured the effective operation of old ideas. The really fundamental changes are two in number: (1) the abolition of the time franchise and the substitution of the indeterminate permit, whereby a company may continue in business under the assurance of a fair rate of return on its fair capitalization; and (2) the prohibition of a second utility where one already exists, with the resulting abolition of ruinous competition. Regardless of their effectiveness in producing the desired results, these two provisions, together with that providing for valuations, represent the legislature's attempt to place the common law rights as well as the common law duties of the utility company on a sound economic basis. It has neither added to nor subtracted from the rights and duties of public utilities as those rights and duties have been accepted for hundreds of years. It represents only the last great step in the process of establishing economical machinery for insuring the recognition of those rights and duties. One cannot study the history of regulation without realizing that the Wisconsin law stands at the end of a course of development in which every step has been logical and inevitable. It is radical only in the proper sense of the word, namely, that it goes to the root of the matter, not in the sense that it departs from the regular course of economic development. It was economically inevitable and if it had not come in Wisconsin it would have come in some other place.

The history of regulation teaches a lesson that we are just beginning to learn. The old principle that in governmental activity minimum quantity means maximum quality has not stood the test in public service; it has operated to the benefit of only those whose business thrives on confusion. The expansion of legislative activity is in the program of economic development and it will come whether we like it or not. Since industry does not thrive on confusion it is surely the part of wisdom to make legislative regulation more scientific, more economical and more effective.

The thread of development leading from the first conception of the responsibilities of business men toward the public, down to the maturest form of legislative regulation is unbroken. The definition of public interest that may affect private business has always been at the disposal of the legislature; this definition has never postulated the existence of a franchise, the right of eminent domain or anything but evident necessity; the duty of defining public interest and of putting the duties and responsibilities of public utilities has been forced upon the legislature by the chaotic results of court procedure; and the Wisconsin Public Utilities Law of 1907 represents the inevitable form of the exercise of that legislative function, borne and matured in the atmosphere of economic necessity.

Volume 20 **Founded 1890** **Number 5**

The Wisconsin Engineer

$1.00 a Year **15c a Copy**

Articles herein may be reprinted but due credit must be given.

Entered as second-class matter Sept. 26, 1910, at the postoffice at Madison, Wis., under the Act of March 3, 1879.

Published monthly from October to May, inclusive, by the WISCONSIN ENGINEERING JOURNAL ASSOCIATION, Engineering Bldg., Madison, Wis.

Chairman—R. C. DISQUE, B. S., Ass't Professor of Electrical Engineering.
Secretary—C. I. CORP, M. S., Assoc. Prof. of Hydraulic Engineering.
M. C. BEEBE, B. S., Professor of Electrical Engineering.
J. G. D. MACK, M. E., Professor of Machine Design.
E. C. HOLDEN, E. M., Professor of Mining & Metallurgy.

Address all communications to The Wisconsin Engineer.

Subscription price $1.00 a year if paid before February 1; $1.25 a year after that date. Canadian subscriptions, $1.25 a year. Foreign subscriptions, $1.50 a year.

THE STAFF

EDWIN L. ANDREW, *Manager.*
DANIEL F. BRESLAUER, *Advertising.*
A. C. MCCULLOUGH, *Ass't Advertising.*
CHARLES GOLDAMMER, *Circulation.*
R. E. PORTER, *Ass't Circulation.*
JOHN E. WISE, *Editor.*
EDWIN A. KAUMHEIMER, *Ass't*
S. C. HOLLISTER, *Campus.*
E. B. KURTZ, *Alumni.*

Ass't Professor R. C. DISQUE, Advisory Editor.

EDITORIALS

By the time this issue is out, the new semester will be upon us. With the beginning of the new semester there will come again the ever present temptation to "let things slide;" we think there is lots of time coming; we want to rest after the strenuous exam and pre-exam period; but we do not seem to realize that we are simply making possible a more strenuous finish for the new semester. We should remember how pleasant it is in the spring to be able to get out to the baseball games, to stroll along the Drive, to go canoeing, or to rest a bit, without feeling that we should be at work.

Let us then resolve to do all of today's work now and not leave it till next week.

* * *

We are trying to make the ENGINEER represent the College of Engineering as nearly as possible. In doing this we want to represent the alumni, the faculty and the students. We want you to feel that this is your magazine. If you see any defect let us know and we will see what can be done; if you have something you wish to bring before others write us about it; if you have some problem, perhaps we can bring it to the attention of some one who can help you; if you wish to see some department changed let us know.

* * *

On another page of this issue will be found the announcement and preliminary program of the annual meeting of The Engineering Society of Wisconsin. This society has among its members practical engineers from all parts of the state. The discussions at the meeting will be well worth the time to hear them, and every student should try to hear some of them at least. The meetings will be held in the Engineering Building and will be open to all. Any senior in the College of Engineering is eligible to membership.

* * *

Last fall agitation was started to have the Engineer's Minstrels again this year. After some hard work and diplomacy by the men appointed to get things started, the permission of the Life and Interests committee was secured. Next a committee was elected to take general charge, appoint a business staff, and select a coach.

These men have done their part, but they can not make the show go without the help of the whole college, so let's get behind them and show our PEP.

THE END OR THE MEANS

"Well, I had the right method anyway, even if the answer was off." This remark, so often heard in student circles, leads one to wonder what the primary purpose of a technical education is. In the effort to emphasize and drive home the salient points of a theory or principle, as illustrated by some specific problem, the instructor often loses sight of the leading purpose of calculation as applied to all forms of work, practical or purely theoretical.

Calculations should lead to results. They are the means to an end, even if they be performed mainly for the purpose of affording the student practice in the operations involved. Therefore the condoning of errors in calculation on the ground that the method employed is correct, is a practice that ought to be discountenanced by the faculty of the engineering school. No less a man than Dr. Charles P. Steinmetz, who has often been called the greatest electrical engineer of the United States, is authority for the following: "The most important and essential requirement of numerical engineering calculations is their absolute reliability. When making a calculation, the most brilliant ability, theoretical knowledge, and practical experience of an engineer are made useless, and even worse than useless, by a single numerical error in an important calculation.

"Reliability of the numerical calculation is of vastly greater importance in engineering than in any other field. * * * With the most brilliant engineering design, however, if in the numerical calculation of a single structural member an error has been made, * * * the structure collapses, and with it the reputation of the engineer."

Habits are hard things to break. It is no more difficult to perform arithmetical operations correctly than it is to do them incorrectly. But the habit of careless computation, once formed, is, like the family skeleton, likely to make its presence felt when least desired. No man can work at his best if he lacks confidence in his own work, which he must if in his mind the means, calculation, takes precedence over the end, results.

STEAM AND GAS ENGINEERING DEPARTMENT NOTES

Many changes have taken place in the last twelve months in the Steam and Gas Engineering Department, both in the faculty and laboratory equipment. An account of these changes should be interesting to all engineering graduates.

Prof. J. G. Callan, who replaces Prof. H. J. Thorkelson as head of the department, is a Mechanical Engineering graduate of Massachusetts Institute of Technology class of 1896. Since graduation, from 1897 to 1909, he was associated with the General Electric Company in a great many capacities. From 1900 to 1903 he was on the personal staff of Prof. Elihu Thompson, consulting engineer for the General Electric Company at the Lynn Works. From 1903 to 1907 he was one of four engineers, chosen by the General Electric Company, to develop the Curtis steam turbine. Because of the drop turbine development in this country due to the panic in 1907 and 1909, he took up commercial engineering on turbine air compressors, centrifugal pumps and low pressure turbines for the General Electric Company. The work on the development of the Curtis steam turbine took Professor Callan to France, Germany, Switzerland and Great Britain. From 1909 to 1915 Professor Callan was associated with Arthur D. Little, Inc., Boston, Mass., as consulting engineer. His consulting experience while with this company includes all branches of engineering. While with Arthur D. Little, Inc., Professor Callan gave a course in steam turbines two years at Columbia, one year at Harvard and one year at Stevens.

Associate Prof. G. L. Larson is a graduate of Electrical Engineering, University of Idaho, 1907. Since graduation he was with the General Electric Company in their testing department for two years and from 1909 until 1914 he was successively Assistant Professor, Associate Professor, and Professor of Mechanical Engineering, Univerity of Idaho. In 1914 Professor Larson accepted a Fellowship in the Mechanical Engineering Department of the University of Wisconsin and received the Degree of Mechanical Engineer, June, 1915. During the second semester, 1914–15, he held an Assistant Professorship in the Steam and

Gas Engineering Department. During the last four years at the University of Idaho he was graduate manager of athletics.

Mr. A. H. Aagaard, Instructor in Steam and Gas Engineering Laboratory, is a graduate of the University of Illinois, Mechanical Engineering, 1914. Mr. A. S. Romig, Instructor in Steam and Gas Engineering Laboratory, is a graduate of Mechanical Engineering, Purdue University, 1913, and takes the place of Mr. A. E. Berggren.

Mr. A. E. Berggren, associated with the Steam and Gas Engineering Department from 1910 to 1915, resigned December 1 to accept the position of Mechanical Engineer with the Faultless Rubber Company at Ashland, Ohio. Mr. Berggren's work was appreciated by all members of the department and his loss is keenly felt.

In the laboratory a new switchboard, similar to those in use in the Electrical Engineering laboratory, has been installed to facilitate the distribution of electric current. Two 7,500 lb. Fairbanks Morse scales have been added to the equipment of the Nordberg Cross Compound Steam engine. These scales are for use in weighing cooling water from the condenser. An eight cylinder automobile engine, manufactured by the Buda Company, and a six cylinder Chalmers automobile engine have been added to the gas engine equipment. A Hospitalier Carpentier Manograph for indicating high speed internal combustion engines has also been added to the gas engine equipment. This is a very interesting piece of apparatus and enables the students to see graphically the changes in pressure in a cylinder due to changing the spark and throttle. The largest addition to the apparatus is a Sprague Electric Dynamometer for testing automobile engines. This apparatus has a capacity of 150 H. P., from 2,000 to 3,500 R. P. M. and will equip the laboratory to handle tests on all kinds of high power and high speed internal combustion engines.

The research work conducted by Prof. G. L. Larson on the heating and ventilating system of the University High School was published in the Proceedings of the Heating and Ventilating Engineering Society in the October, 1915, Journal and read at the annual meeting of the society in New York in January, 1916.

Advance Program for Engineering Society

Madison, Wis., Jan. 26, 1916.

Members of Engineering Society of Wisconsin:

Below you will find the program for the coming 7th annual meeting of our Engineering Society. A vote of the members outside of Madison showed that a majority favored having this meeting at Madison.

It is believed that this program promises a real treat to those attending. The discussion of the "Relation of Contractor and Enginneer" as well as Mayor Adams' paper on "Open Specifications" are certain to cause a thorough discussion. Now show your interest and loyalty in the Engineering interests of the state by attending the meeting and bringing some friend with you if possible. Fifty new members have joined the society during the year. "It is a good thing, push it along."

Yours for service,

L. S. Smith, *Sec. and Treas.*

FEBRUARY 25

2 P. M. Meeting called to order.
President's Address.
Report of Secretary and Treasurer.
Appointment of Committees.

3 P. M. Paper—Relation of Engineers and Contractors.
Discussion led by George Stanchfield, J. C Ph.nney and others.

4 P. M. Paper—State Inspection of Public Utilities, by A. C. Larson, Chief Engineer, Railroad Commission.
Discussion led by F. G. Summons, Director, Pub. Works, Milwaukee.

5 P. M. Some Phases of the Wisconsin Building Code Work, by S. J. Williams, State Inspector.

6:30 Annual Banquet University Club.

8 P. M. Flood Protection at Dayton. Prof. D. W. Mead.

FEBRUARY 26

9 A. M. Asphalt Concrete Pavements. W. F. Reichardt.

9:30 Surface Treatment of Old Macadam, By James R. Valk.
Discussion by A. E. Ashbrook and J. E. Gillespie.

10:00 Beloit's Experience with Open Specifications. Mayor H. W. Adams.
Discussion led by City Engineers Connelly and George Randall.

2 P. M. Milwaukee's Experience with Sewage Treatment, by T. Chalklow Hatton.
Discussion led by C. V. Seastone.

3 P. M. The Water Softener and Its Function In the Treatment of Boiler Feed Water. H. R. Dorman.
Paevment Guarantees.
Report of Committees.
Election of Officers.
Adjournment.

ALUMNI NOTES

WHAT OUR 1915 "GRADUATES" ARE DOING

Gilman R. Smith m '15, who is taking one year of work at the Mass. Inst. of Tech., is also working in the Traffic Dept. of the Boston Elevated Ry. Co., during the afternoons. His address is 174 Saint Botolph St., Boston, Mass.

W. F. Heineman m '15, is machine shop foreman at the Allis Chalmers Mfg. Co., Milwaukee, Wis.

Edwin S. Herried m '15, is in the Engineering Dept. of the Central Illinois Light Co., Peoria, Ill.

William Wallace Innes c '15, who was working in the Engineering Dept. of the city of Milwaukee, is now in the engineering corps of the American Rolling Mill Co., at Middletown, Ohio.

Franklin Gray Pardee min '15, is in the flotation department of the Portland Gold Mining Co. His address is Baltimore Hotel, Victor, Colorado.

J. H. Gehrmann Ch. E '15, is assistant mechanical superintendent of the Hammond Standish & Co. Packers, Detroit, Mich.

H. W. Rusch e '15, is draftsman in the electrification department of the Milwaukee Railroad. His address is C. M. & St. P. Electrification Dept., State Savings Bank Bldg, Butte, Mont.

W. V. Dargan min '15, is in the testing department of the Anaconda Mining Co. His address is, The Flood Block, Anaconda, Mont.

Roy Brook Kile e '15, is on the regular testing force on automobile equipment of the Westinghouse Electric & Mfg. Co. His business address is 5102 Baum Blvd., Pittsburg, Penn.

R. H. Grambsch e '15, is foreman in the Service Repair Dept. of the Delco Mfg. Co., Dayton, Ohio.

Thomas S. Burns e '15, who was formerly associated with the Burns Bros. firm is now Engineer with the Northern New York Utilities, Inc. His business address is Route No. 2, Castorland, N. Y.

E. T. Lorig m '15, is draftsman for the Dravo Contracting Co., Pittsburg, Penn.

Charles H. Klotz m '15, is Valuation Compiler for the Chicago, Milwaukee & St. Paul Ry. His business address is West Milwaukee Shops, in care of Mechanical Engineer.

Paul Coddington m '15 is Residual Engineer for the Laclede Gas Light Co., St. Louis, Mo.

H. A. Marshall c '15, is Junior Engineer with the Illinois State Highway Department, Springfield Ill.

F. W. Colbeck m '15, is mechanical engineer with the Rockford Gas Light & Coke Co., Rockford, Ill.

Carrington H. Stone e '15, who was with the American Carbon Co. of St. Louis, is now in the testing department of the Commonwealth Edison Co., Chicago, Ill.

W. A. Goss c '15, who was formerly with the city engineer of Mason City, Iowa, is now in the valuation department of the C. & N. W. Ry. His address is C. & N. W. Ry. General Offices, Chicago, Ill.

Edward A. Sipp e '15, is testing engineer with the Sulzberger & Sons Co. of America, Chiacgo, Ill.

Elmer L. Goldsmith e '15, is now studying Patent Law. His address is: Miller & Chindahl, Patent Attorneys, 1515 Monadnock Block, Chicago, Ill.

W. C. Raube e '15, is testman at the General Electric Co., Schenectady, New York.

Harold O. Davidson min '15, is Assistant Engineer with the Oliver Iron Mining Co. (Gogebic District). His business address is: 511 Vaughn St., Ironwood, Mich.

F. W. Hodson min '15, is Assistant Engineer for the Big Creek Coal Co., St. David, Ill.

Charles F. Loweth C. E. '15, is Chief Engineer for the C. M. & St. P. Ry. His business address is: 1345 Railway Exchange, Chicago, Ill.

Harry F. Oldenburg m '15, is draftsman at the Universal Mach. Co. & Steam & Gas Lab. Instructor at Continuation School.

G. H. Blanding m '15, is solicitor for the Johnson Service Co. His business address is: 177 N. Dearborn St., Chicago, Ill.

Bjarne Knudsen min '15, is Engineer for the G. W. Young Mining Co. He now stays at Iron River, Mich.

C. W. Zachow m '15, is Assistant Engineer for the Soo Line Ry., Chicago Division. His address is: Fond du Lac, Wis.

H. B. Heyn ch '15, who was formerly with the Harbison-Walker Refactories Co., Pittsburgh, Pa., is now Research Fellow in the Mellon Institute, of Pittsburgh, Pa.

W. J. Freeman M. E. '15, is Consulting Engineer. His office is in the Washington Bldg., Madison, Wis.

Louis F. Reuter Jr. c '15, is Engineer with Paul Riesen & Son, Inc. His address is: 1018 Humbolt Ave., Milwaukee, Wis.

E. J. Connell M. E. '15, who was recently associated with the Llewellyn Works at Los Angeles, Cal., is now in the Office-Quotation Dept. of Joseph T. Ryerson & Son, at Chicago, Ill.

W. L. Breckenridge Jr. m '15, is now connected with the Ford Motor Co. His business address is: 39th & Wabash Ave., Chicago, Ill.

W. S. Bemis M. E. '15, is appraisal engineer with Prof. Edward W. Bemis, at 4500 Beacon St., Chicago, Ill.

Aaron A. Ladon ch '15, is doing electrical research work for the Western Electric Company, Inc., at Chicago, Ill.

Henry L. Levi m '15, is Fellowship Secretary at the Racine Y. M. C. A., Racine, Wis.

Harrison L. Garner C. E. '15, is Instructor of Hyd. Eng. at the University of Wisconsin.

"Jack" Reed e '15, entered the Testing Department of the Diehl Mfg. Co. immediately after graduation, and was recently transferred by the Sales Organization to the Printers Equipment Department, with offices at 90 Prince Street, New York City.

E. R. Adlington e '15, went along with Reed to the same company and also entered the Testing Department; he has also been transferred to the Main Sales Office at Elizabeth, New Jersey. The address of Reed and Adlingtgon is: 91 West Jersey St., N. J.

T. O. Reyes c '15, advises that he is now employed in the Bureau of Public Works, Catbalagan, Samar, Phillipine Islands.

* * *

E. R. Stivers c '15, who has been working with the Chicago Burlington & Quincy Railroad since graduation has been transferred from the construction work on the change of line along the Mississippi River which was nearing completion, to Missouri where he has been making surveys of drainage conditions. He He writes:

"The work here is gathering engineering data to fight several damage claims against the company. Last spring and summer the rains down here were unusual and excessive. Nearly all of the low lands adjacent to the railroad for miles on both sides of the many creeks were inundated. About forty damage suits have been brought against the railroad company, most of them charging that the railroad had insufficient opening through the dump at the various creeks.

"We run levels along the track and up the creek for a couple of miles getting all high water marks we can. Then we get the elevation of the ground, and locate the crops. The openings at the railroad and highway bridges are also determined. From this and other data already in the office we plot profiles, maps and cross sections."

* * *

R. T. Cavanaugh c '15, who has been working on the Erie Canal under the State Engineer of New York writes interestingly of his work as follows:

"I reported at Amsterdam directly after leaving Madison and went to work the next morning. Up until last Sunday I have worked every day his summer. We are not working Sundays from now on, however. My work during the summer has been on a new highway bridge over the Mohawk river. The river is canalized here and the work comes under the direction of the state engineer. I have done all the direct layout inspection on the bridge up to date. I had two Cornell graduates and two other men with me all summer. The engineer in charge comes over about twice a day and gives directions for the work.

"The new bridge is of the cantilever type, 430 feet backwall to backwall. The piers are 107 feet from the abutments, leaving a channel for the barge canal of about 200 feet between piers. The piers are concrete. Up to date we have completed the piers and abutments and have several panels of floor system in.

"Three different types of foundations were used. The north abutment is founded on a rock ledge which slopes gently to a point several feet under the north pier and then drops off to no one knows where, in a perpendicular line. This feature caused us no end of trouble during the work. The preliminary survey and plans indicated that there was rock under the entire pier, but in reality the rock that was sounded was only boulders. We had the two abutments completed and the steel was all designed and on the job, so we had to do the best we could with the foundation. Steel sheet piling was driven to confine the soil under the footing and the pier was built. We had four floods which in each case washed out the cofferdams and filled in the excavation. I learned a good lesson which I remember was often pointed out and that is to be sure of the geology of your site before you plan a structure.

"The south abutment of the bridge rests on wooden piling driven in a glacial deposit of gravel. Old pile drivers who were on the job said that it was the most difficult piece of work they had ever seen.

"The south pier was built even differently from the others. On account of the depth of the water and the floods it was decided to drive steel sheet piling around the flooting. This was filled with class A concrete nine feet high or up to the bed of the river. The twenty feet of water was pumped out and the shaft of the pier started. This proved to be a very satisfactory method."

* * *

In a recent letter received from R. D. Hughes, Manager of the Chicago Sign Department, he included much interesting news regarding some of his alumni friends. Extracts are as follows:

Bill Fitch M '13, was in town the other day on his way home for Christmas. Bill is managing the Indianapolis Office of the Dravo-Doyle Company and is making things hot for his competitors thereabouts and through the states of Indiana, Ohio and Kentucky.

Steve Gregory m '13, has just taken a new position with the Walker Vehicle Company, who manufacture the Walker Commercial Trucks and Chicago Electrics.

I saw Eddy Gillette for a minute last week, but forgot to ask him what he is doing. He looked fat and prosperous.

My brother D. R. Hughes is with the Experimental Department at the Stewart-Warner Speedometer Corporation, and expects some day to get a raise.

Ed Whitney has started on his annual Southern trip with the Inter-State Commerce Commission. Ed certainly likes to go South for the winter.

Edward Wray, ch '05, E. E. '06, Publisher of the *Railway Electrical Engineer,* has sold his interest in the magazine, but has been retained by the purchasers as Managing Editor. He makes his residence at Westfield, New Jersey.

A. U. Hoefer m '06, was transferred from the Chicago Telephone Company to the American Telephone and Telegraph Company, with offices in New York City.

A number of the recent graduates have visited the college within the past few weeks. They are as follows:

H. L. Alger c '13 is with the Sanitary District of Chicago, and has been engaged in the remodelling of the Thirty-Ninth St. Pumping station.

F. C. McIntosh c '13, is working with the Penn. Railroad Co. on the construction of the New Union Passenger Station at Chicago. He has been obtaining some valuable experience in foundation work chiefly in the line of pile driving. He states that, contrary to the usual practice at the present time in Chicago, piles rather than concrete footing columns or "caissons" are being used in the new buildings.

B. E. Anderson c '15, is with him on the same work.

S. H. Phinney c '14, and E. K. Smith c '14, came up from Beloit where they have been working with the City Engineer. Smith is still with the City, but Phinney is going to be on some drainage work near Green Bay.

W. P. Bloecher c '14, is with the Baltimore & Ohio, working on the construction of an engine terminal at Chicago. He speaks feelingly of the difficulty of accomplishing results under the handicap of Labor Union conditions as they exist in Chicago. He has learned that in addition to the technical side of engineering there is a human side of it that complicates every engineering problem.

Edward H. Tashjian c '14, has been with the Milwaukee County Highway Commissioner as inspector, until the work closed for the season. He stopped at Madison on his return from the Mayo Brothers hospital at Rochester, Minn., where he had an operation for an ear trouble of long standing.

* * *

L. C. Street ex—c '98, his wife and small daughter passed through Madison on Dec. 31st. Street is an old crew man and was one of the famous aggregation that went east, cleaned up Yale and inspired our w. k. Mendota Crew Song. And by the way, Mr. Walter Alexander of the Railroad Commission was captain of that same crew.

Street was one of several Wisconsin men, who were employed on the railways of Mexico until recently. He remained in the country until two years ago, in spite of the unsettled conditions and was in Mexico City during the ten-days' battle in 1913.

Since the revolutions began in that country the life of the engineer has been more or less hazardous and exciting. While division engineer of the Cardenas Division of the National Railways, Street was "crowned" with a rock by a peon while he was trying to help some Chinese defend a company restaurant at one of the way stations in the mountains. He had a bad eye for a time and his coat was ruined by knife thrusts, but he managed to send some of the looters to the "shops" for repairs, and furthermore he stuck to his job.

Since returning to the States, Street has been engaged in reclamation work near New Orleans. At present he is visiting his people in Dixon, Ill.

CAMPUS NOTES

Tested under extreme weather conditions transcontinental telephony was demonstrated exceedingly well at the meeting of the Madison Section of the A. I. E. E. on Jan. 12th, 1916. Mr. Seymour, Manager of the Wisconsin Telephone Company, gave a talk on the operation and difficulties encountered during its construction. Professor Bennett gave a very interesting talk on "Loaded and Unloaded Telephone Lines." The main part of the program for the evening was the demonstration. Through the courtesy of the Wisconsin Telephone Co. and the American Telephone and Telegraph Co. direct connection was made to San Francisco. After California was on the other end, roll call was taken of the different stations along the line. Starting with New York the "here" was distinct as it came over the wire and the different "here's" became louder as the place of sending came closer to this state and then gradually became fainter as the voice came from a greater distance. When Governor Philipp of Wisconsin heard Governor Johnson of California tell of the nice warm weather there while we were having "sure signs of winter," we were assured that talking over a distance of 3,000 miles was no longer a mere possibility but a practical reality. The Governor sent the greetings of Wisconsin to California which were heartily accepted. President Van Hise carried on a very interesting conversation with Professor Barker of the University of California. Hearing so much about the lovely weather at the other end of the wire Prof. Maurer ordered a few "red hot calories" to be delivered in the morning. The delivery was somewhat delayed, but they got here. Various other members of the faculty of the University carried on conversations with members of the faculty of the University of California. The audience at this end was treated with "On Wisconsin" over the wire, and showed the proper spirit by giving a loud "sky-rocket" which was heard in California. The Denver operator brought the program to an end by demanding the use of the line.

Professor W. S. Franklin's address, "Some Mechanical Analogies in Electricity and Magnetism," given before the College of Engineering January 10, was one of the most interesting of the lectures which have been given this year. Although the address and demonstrations were of a strictly electrical nature, they were given in a manner which made them interesting to a student of any phase of engineering.

After briefly pointing out the similarity between the mathematical laws which govern both electrical and mechanical phenomena, Professor Franklin performed a number of experiments, and showed several slides which brought out these analogies in a very comprehensible manner.

Professor Franklin was professor of Physics at Lehigh University for many years. He is interested in educational matters in general, and has written a number of books on Physics, mathematics, and electricity. He is author of the rather well known essay, "Bill's School and Mine."

Professor Franklin also lectured before the Science Club while here.

* * *

The Engineers Club has under the new administration started a campaign to get talks by the faculty men in various departments. The Standards Laboratory, its origin, growth, and work was ably covered by Director Kartak.

* * *

The senior Mechanicals and the members of the class in Water Power Engineering were recently treated to a lecture on Uniflow Engines by Prof. Callan. Professor Callan is making himseld respected and liked by all. An abbreviated account of his experience will be found on another page.

* * *

In the various laboratories new and surprising collections of apparatus are being set up. The seniors are beginning to be seriously busy on their theses.

* * *

Another smoker for the students and faculty is being arranged by the Engineers' Club for a date early in the second semester.

IN MEMORIAM

If one were to pass rapidly through a compendium of the lives of the engineers who have graduated from the University of Wisconsin, and gone out into the commercial world, he would find here and there one who has accomplished, or is accomplishing, a task of sufficient moment to warrant the statement that he has achieved what the world choses to call success. And if we consider as a worthy achievement, the subduing, readjusting, and adapting of the forces and resources of nature to better the conditions of one's fellow-men, then the successful engineer is indeed successful. Such a man was Mr. Edwin T. Munger, U. W. class of 1892.

EDWIN T. MUNGER

Mr. Munger was born in Green Bay, Wisconsin. He graduated from the Menominee High School in 1888, entered the College of Engineering of the University in the fall of the same year, and in 1892 became the first graduate of the course in Electrical Engineering.

That Mr. Munger was chiefly interested in electric railway construction and operation, is shown by a brief resumé of the work in which he was engaged after leaving the University.

For the first two years subsequent to his graduation Mr. Munger was employed by the Hall Signal Company and the National Switch and Signal Company. From 1894 to 1896 he was wireman and foreman of the Metropolitan West Side Elevated Railroad of Chicago. He then served one year as general foreman for the Englewood and Chicago Street Railway Company. His connection with this company terminated with the panic of 1897, and he became Superintendent of the Havana Electric Company of Havana, Ill., and later part owner of the Havana Telephone Company, which he combined with the Electric company. Ill-suited climate caused him to leave Illinois, and after engaging for three years in electrical and mechanical construction in Green Bay, he again became associated with the Metropolitan West Side Elevated Railroad as master mechanic, and later as general superintendent. On January 1, 1909, Mr. Munger became general superintendent, and began the re-organization of the Hudson and Manhattan Railroad Co. of New York City. This company constructed and now operates the tunnels under the Hudson River.

Thus far, in the twenty-two years of his life as an engineer, Mr. Munger had never remained long in the service of any single company, always leaving one position to take up another with greater opportunities and responsibilities, and, in 1914, he again accepted a new position; this time as general superintendent of a large railway combination in Maine, with headquarters in Portland. He began a general reconstruction of these lines, but on Nov. 14, 1915, death called him from this last task, and closed the life of one who was not only Wisconsin's first electrical engineer, but also one of her most succesful ones.