The Wisconsin engineer. Vol. 20, No. 7 April 1916

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

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

The Wisconsin Engineer

Vol. 20 APRIL, 1916 No. 7

ELECTRICITY IN THE HOME

THE MANUFACTURE OF LINOLEUM

BELOIT'S EXPERIENCE WITH OPEN PAVING SPECIFICATIONS

CONTENTS.

The Wisconsin Engineer

VOL. XX APRIL, 1916 NO. 7.

ELECTRICITY IN THE HOME*

S. J. GATES
Commercial Engineering Department, T. M. E. R. & L. Co.

"Electricity in the Home"—To whom does it not speak volumes? From the introduction of the electric bell a century ago to the present day, electricity has gradually progressed towards its ultimate replacement of all other domestic servants. The inertia of the people, their "angle of lag" or "power factor," rather than the lack of energy of the electrical man is responsible for the fact that the future and not the present will see the universal home electrical.

INERTIA OF PEOPLE

The slowness of the people to acquire new habits is clearly demonstrated by the electric bell. When it was first introduced door bells in use were of the pull handle variety. In order to get people to use electric bells, as any electrical contractor will tell you, the pull rod was arranged to make contact with the battery circuit. The first installation of push buttons were made in restaurants and it was necessary to place a sign marked "Push" above the push button and later a sign marked "Bell" below in order to get patrons to use it. Electric bells were followed by the many annunciator systems familiar to all.

DEVELOPMENT

Additional applications of electricity to the home were slow in coming. In 1876, however, Dr. Alexander Bell and Elisha Gray filed their memorable caveats on the telephone within two hours of one another and that indispensable home necessity was introduced. Two years later Edison brought out his electric

* Excerpts from a paper read before Milwaukee Electric League.

lamps after some of the most painstaking and thorough research work recorded in history, and in 1881 the central station industry was born in Appleton. From this time the application of electricity to the home has grown so fast that the statisticians have been kept "on the jump" to keep pace with it and today we find an employe of the Philadelphia Electric Company in a prize contest able to name 193 electrical appliances for use in the home. Of these devices, seven had twenty-four practical uses.

A home may be described as a factory whose "unit of manufactured output" is happiness. It may approach a miniature heaven or something else, depending upon the effectiveness with which it makes happiness. Until recently women had never conceived the idea of doing housework in any other way than by hand, whereas man in his factory and shop had become accustomed to steam and electricity. It therefore required time to convince the housewife that as a servant in the home, electricity is "always at hand", "always willing to do its alotted task and to do it perfectly, silently, swiftly and without mess; never wants a day off; never answers back; is never laid off; never asks for a raise; in fact, it is often willing to work for less money; never gives notice and doesn't mind working overtime; it has no prejudices and is prepared to undertake any duties for which it is adapted; it costs nothing when not actually doing useful work." Such are the merits of the housewife's new ally. By its use the commonest tasks are transformed into pleasures, swiftly and skillfully performed.

APPLICATIONS

The application of electricity to the household has introduced the same sort of orderliness, cleanliness, and scientific management that have become the rule in the business world. Why mention or describe the many appliances when all are so familiar with their use and advantages? The almost universally used electric iron, the dirt devouring vacuum cleaner, the ruddy glow of the electric radiator, the comforting warmth of the heating pad, the sewing machine with its 30,000 stiches for a cent, the toaster, the washing machine, are but a few of the rational luxuries afforded by electric service.

Recently there has been placed upon the market an electric dish washing machine applicable to the household. The tedious process of washing and wiping dishes requires about three hours per day for the average family. It is said that the motor-driven dish washer will save sufficient time to pay for itself in one year.

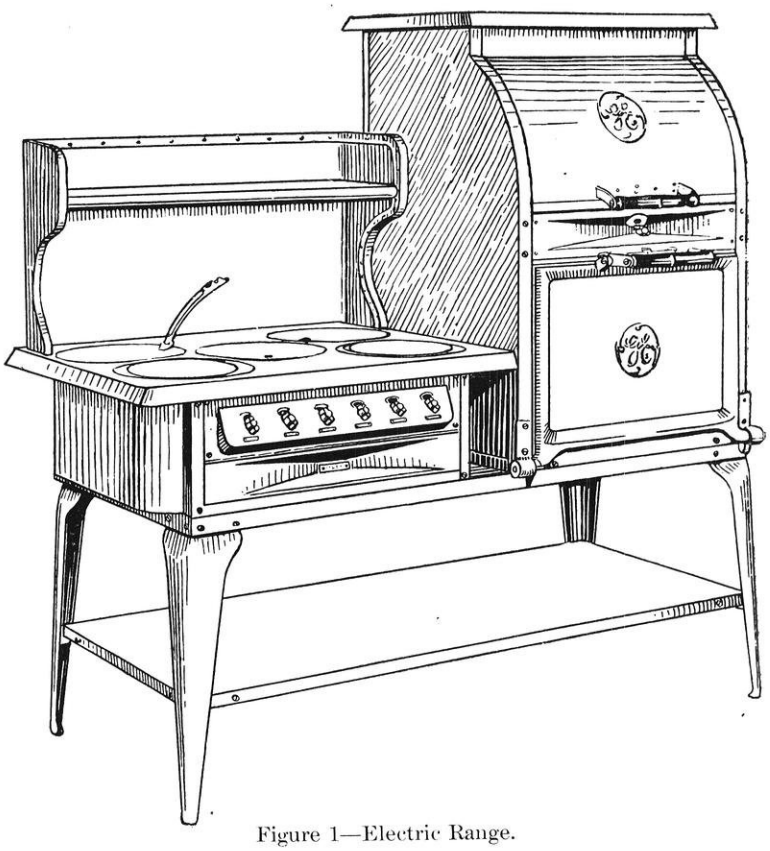
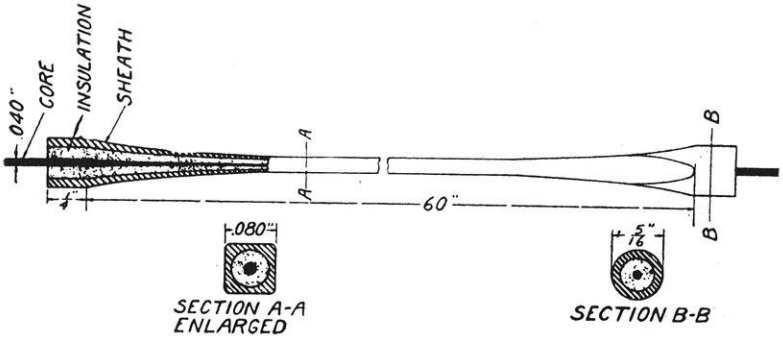


Figure 1—Electric Range.

About twenty-five years ago modern electrical cooking began in England. Twenty-one years ago an eight course electrically-cooked banquet was given by the City of London Electric Lighting Company. The development of electrical cooking and heating was retarded somewhat by the difficulties encountered in the search for a suitable heating element. After a time ingenuity and persistence solved the problem and for the last five years wonderful strides have been made in this line.

The subject of electric ranges is an interesting one to engineers because of the many examples of ingenious engineering work in their design and manufacture. For example let us take the General Electric "Sheathed Wire" illustrated herewith. This wire in the form of open coils or buried in a hot-plate casting is the form of heating element used in the ranges manufactured by that company. The sheathed wire consists of three parts,—the current carrying wire, the insulation, and the protecting sheath. In brief the process of manufacture is as follows: A high resistance wire about one-eighth inch in diameter is placed in the center of a steel tube about one inch in diameter. The space inside the tube is then packed with an insulating ma-



SHEATHED WIRE
Figure 2.

terial. The tube, insulating material and resistance wire are then swaged out and drawn down until the outside diameter of the tube is about one-eighth inch and the diameter of the resistance wire is about .010 inch. The quality of the insulating powder is such that these units heat up quickly and the protective sheath makes them durable.

Progress is shown by the recent construction of an apartment house in Buffalo in which there are installed forty electric ranges, and in Milwaukee an apartment house which will be equipped throughout with electric ranges is now in the course of construction. Thus is electricity doing its share in the performance of the functions of the home, and those of us who see its use growing daily hesitate to speak of the future. Some who are in-

clined to be skeptical and pessimistic regarding the future of electricity in the home are advised to take heed lest they bring ridicule upon themselves in the years to come. The following is taken from a "Contribution to the History of Electric Lighting," written in 1879 by W. M. Williams, a Fellow of the Royal Academy of Science:

"During the intervening thirty years I have abstained from further meddling with the electric light, because all that I had seen then, and have heard of since has convinced me that although as a scientific achievement the electric light is a splendid success, its practical application to all purposes where cost is a matter of serious consideration, is a complete and hopeless failure and must of necessity continue to be so."

Let us rather be optimistic and visionary like Professor John Perry who said in 1881 that the "whole power of Niagara might under some circumstances be transmitted to New York through a single telegraph wire!"

UNUSUAL INSTALLATION

As an example of how far we can go in the application of electricity in the home, attention is called to what has been referred to as the World's Greatest in residential electrical equipment, the home of Sir Henry M. Pellatt, which occupies some fifteen acres in the city of Toronto. Mr. Pellatt is President of the Toronto Electric Light Company and was instrumental in the electrical development of Niagara Falls. The total electrical requirements of this home exceed 400 kilowatts, an amount sufficient for the towns of Fort Atkinson and Jefferson combined. Current is transformed in the residence from 4,000 to 550–220–110 volts and distributed at 25 or 60 cycles. The installation is replete with electrical effects too numerous to mention in this article.

CLEVER INVENTIONS

There are many striking examples of inventive genius in the development of electrical devices and appliances for use in the home. One of the most useful of these is the bell transformer. This little device eliminates all the inconvenience of batteries and consumes only .9 watt in operation.

Electric service companies have found that one of the causes of high bill complaints has been the forgetfulness of some of the customers who sometimes leave the cellar lights burning all night. To eliminate this a buzzer has been devised which operates when the cellar light is switched on but ceases when the light has been turned off. This gentle reminder will help keep electric bills down.

One of the advantages which gas has had over electricity for lighting has been the ease with which the size of the flame (light) could be regulated. To supply the need for a dim light which would consume a small amount of energy the "all nite lite" transformer has been devised. The energy consumed by the transformer combined with that of the lamp never exceeds 3½ watts. At 11 cents per kilowatt hour the device can be operated for 10 hours at a cost of less than ½ cent. The hy-lo lamp and the dim-a-lite socket are designed for a similar purpose. The writer cannot leave the subject of ingenious devices without describing an electric egg steamer which was recently called to his attention. A round tray supported by standards has a depression or well in the center in which two electrodes or elements are suspended a small distance apart. A thin metal disk sets above the tray. The eggs are held endwise in the four holes which are punched out of this disk for this purpose. Separate from the steamer is a small container similar to a test tube on which there are three graduations—soft, medium and hard. If soft boiled eggs are wanted this container is filled with water up to the point marked soft and the water is poured into the well in the steamer. A cover is placed over the device and the circuit is closed. As in an overloaded water rheostat, current passing through the water between the plates heats and vaporizes the water. When evaporation ceases the current is switched off and the eggs are found to be cooked as desired.

FURTHER DEVELOPMENT OF USE

Because of its demonstrated usefulness and the enormous amount of literature and clever advertising on the subjects akin to electricity no further argument is needed now to convince a prospective owner to wire his home for electric service. The home builder or owner is interested in planning his installation

to secure the greatest convenience with maximum economy. For these reasons he desires separate outlets for heating appliances, baseboard outlet for vacuum cleaner, radiator, heating pad or sewing machine motor, 660 watt sockets (a boon to the electric company's trouble men), two-switch control of front room lights, and other refinements in wiring which are easily applied to a new residence. Often times current is kept on an electric iron longer than necessary because one cannot see whether or not the current is on. To eliminate this waste of energy, provision for a pilot light should be made for use with an electric iron.

In the residence lighting field, illuminating engineers and architects are working to make the lighting of the home artistic, attractive, and consistent with its architecture. To help achieve this result there is now an endless variety of fixtures from which to make one's selection. The use of tinted silk shades and colored glass for artistic fixtures is increasing.

Above all else, installation should be planned on a generous basis. Rapid developments are being made and wiring should therefore be so installed that only additions and not extensive alterations will be necessary in the future. Proper liberal allowance for the first installation will encourage expansion with the minimum of expense and thus help to widen the market for wiring, service and appliances, and give the user his full share of the convenience that electricity may provide for the home.

OLD HOUSE WIRING PROBLEM

The advantages of electricity in the home are conceded by all yet we find from the 1912 Report of the Committee on Residence Business of the National Electric Light Association that in cities of 100,000 and over only 23% of the total dwelling houses are wired for electric service. For this reason many schemes have been devised for stimulating the increase of this class of business. One of the most widely used plans is a standard schedule of charge for wiring based upon the number of outlets in a house.

WHAT ONE CENT WILL DO

During legal proceedings against a gas company out west, the attorney for the company made a very eloquent appeal in which

he laid stress upon the excellent qualities of the company. In fact, he said, it was entitled to so much credit that he was reminded of the poem "The Light Brigade." One of the spectators, unable to restrain himself, arose and said, "Oh, how they charged!" The fear that some have this same opinion about electric rates prompts me to tell what a cent's worth of electricity will do. In the larger Wisconsin cities the average rate for residence electric service is about eight cents per kilowatt hour. Assuming, for example, a rate of ten cents per kilowatt hour, we find that one cent's worth of electricity will operate:

A six-pound flat iron fifteen minutes.

An electric vacuum cleaner long enough to clean a room twenty feet square.

A pump long enough to raise 100 gallons of water 100 feet.

A radiant toaster long enough to produce ten slices of toast.

A sewing machine for two hours.

A fan twelve inches in diameter for two hours.

A heating pad from two to four hours.

A chafing dish for twelve minutes.

A foot warmer for half an hour.

A radiant grill for ten minutes.

REDUCTION OF COST OF ELECTRICITY WITH INCREASED COST OF LIVING

Taking into account the increase of efficiency due to improved Mazda lamps and the reduction in lighting rates, it is conservatively estimated that equivalent electric service is about 50% cheaper today than it was ten years ago. During the same interval the reports of the U. S. Bureau of Commerce and Labor show that the cost of food has increased 48%, wages 28%, and clothing 30%. This shows that the central stations have been quick to give the public the benefit of more efficient methods of production and the reduction in cost due to greater density of business. Reduction in cost means more business—more business means further reduction in cost and the effect is therefore cumulative.

CONCLUSION

What is the result of this "cumulative effect" of reduction in rates? Obviously a constant increase in the use of electric serv-

ice in the home. Gradually the domestic problems are giving way before the concentrated attack of ingenious minds. Soon the methods of the home will be consistent with modern standards of living. We read that aversion to domestic service rests on three vital points,—long hours, drudgery, and social indig-

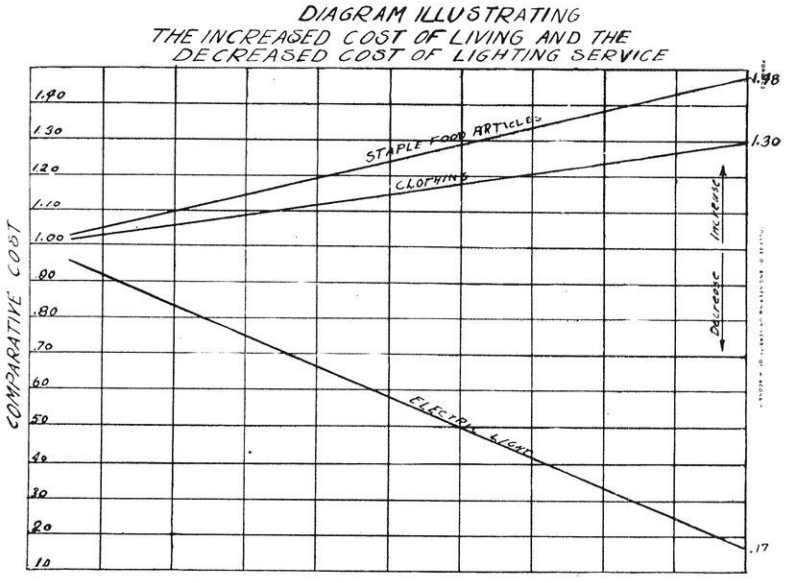


Figure 3.

nity. It remains for electricity to change these conditions.

As A. E. Kennelly tells us in a remarkable article on Electricity in the Household written twenty-five years ago when a foot warmer and a coffee heater were the only appliances which had been introduced:

"Considering then that the household is in itself the condensed history of a nation's past, the center of its present and the cradle of its future, it is doubtful whether among the many triumphs of the age that electricity may claim, any can be quoted of brighter renown than the rapid progress it has already made in the cultivation of the arts of life and its adaption to the needs and graces of the home."

THE MANUFACTURE OF LINOLEUM

R. S. MAGATAGAN, '16

About 1860, F. Walton, an Englishman, took out a patent for making linoleum. As stated in this patent, his process consisted in mixing thoroughly, linseed oil, ground cork, certain gummy and resinous materials with pigments and pressing this mixture onto a canvas backing. This process is practically the same as that used today. Of course improvements have been made in the manner of treating the raw materials; various adulterants have been added; and highly specialized machinery has had much to do with the development of the industry.

Of the above mentioned substances used in the manufacture of linoleum, linseed oil, raw or boiled, is the bonding material. Boiled oil is usually used because it is already partly oxidized and also because its higher viscosity increases the rate of further oxidation. It is claimed however that the raw oil gives a more thoroughly oxidized final product. Certain metallic salts, such as of lead and manganese, known as driers, are sometimes added to increase the rate of oxidation.

It has been found that the active constituent in all drying oil is linolein, a glyceride of linoleic acid. When linolein is oxidized linoxin is formed, the glyceride being used up with the evolution of acrolein. This linoxin is a yellow, elastic mass, heavier than water and quite insoluble in it. It is also insoluble in ether, carbon disulphide, chloroform, alcohol, but softens in boiling benzine under pressure.

Oil used for linoleum manufacture is of a very high grade.

Formerly cork alone was used as the filler, but now considerable wood flour or powder is added. These materials give to the linoleum the property of resistance to wear. The cork comes in bales as "cuttings" and must be washed, ground and sifted. The preliminary grinding is done in a disintegrater and the finishing by grinding with steam on buhrstone mills.

Rosin, amber and other gums, particularly kauri gum are also classed as fillers. These add considerably to the strength and insolubility of the product.

The inorganic pigments most frequently used are: iron oxide, ochre, chrome, French blue and carmine. Analine dyes are not used.

If raw oil is used a preliminary step in the manufacture of linoleum is the boiling of the oil for several hours in open pots until the proper consistency is obtained.

The next step is the oxidation of the boiled oil. This takes place in a well ventilated room maintained at a temperature of about 160° F. The oil is sprayed in from above, collected at the bottom and again returned to the top. The process is continued until the heated air in the chamber has changed the oil to a yellow, viscous mass. In some plants, to give a larger surface for exposing the oil to the air, sheets of canvas, burlap or calico are hung in this chamber about four inches apart. The oil which gathers as a thin film comes off as thin "flakes" when the sheets are passed between smooth steel rolls.

The oxidized oil is then heated in a kettle together with the gums and resins and is formed into large blocks of rubber-like consistency.

These cakes are delivered to a mixer where the cork and the wood pulp are incorporated, giving what is known as a "cement." The coloring matter is added with the cork.

The "cement" is run through calender rolls and made into sheets eighteen inches wide and one-eighth inch thick. These sheets still in a soft, gummy condition are much like soft putty and are now ready to be made into commercial product.

There are three principal grades of linoleum: (1) straight-line-tile inlaid, (2) granulated or molded inlaid (3) plain or printed.

The manufacture of inlaid linoleum grew out of the tendency of the printed linoeum pattern to wear off. The inlaying machine is equipped with dies that correspond in shape to the various forms called for in the design and is provided with a separate die for each color. These dies operate simultaneously to stamp out the different shapes or "tesserae" in their respective colors and adjust them in their proper positions on the prepared burlap. The dies are arranged one behind the other and operate independently over their respective portions of the burlap which is moved forward after each operation of the dies to receive the next shade of the "tesserae." The dies are operated by hydraulic pressure and exert only enough pressure to make the "tesserae" cling to the burlap. The "goods" are then transferred

to the hydraulic press and subjected to three thousand pounds per square inch pressure twice in succession. This treatment squeezes the stamped out tiles onto the burlap in one homogeneous sheet without seam or joint. It is then removed to a room to be cured for four or five weeks at 140 degrees Fahrenheit.

In the manufacture of the granulated or molded linoleum, the material from the mixer is granulated by a special machine and sifted. The designs most used are series of diamonds arranged to form various patterns. A perforated plate with diamond-shaped openings, like a lattice is used as a mold. The granulated mixture is sifted through this mold onto the prepared burlap. To separate the colors into their respective diamonds, as called for in the pattern, a series of pans is laid over the mold, each pan being provided with selective openings that register with the openings in the molds. After one color has been sifted onto the mold another pan is set in place as a template for the next color, and so on. When the entire mold has been filled, it is lifted off and the material is pressed into the burlap. The life of this grade is about one-fourth that of the straight-line-tile, because of the weakening of the bond due to granulating.

The following are some of the physical characteristics of linoleum that determine its value as a floor covering: specific gravity, weight per square foot, thickness and resistance to wear, bending tests over mandrils 10 to 45 mm. in diameter, tensile strength and extensibility, impermeability to water, ether solubility. The ether solubility is perhaps the most important test because it is an index of the completeness of the oxidation on which most of the other tests will depend.

The references found below will be of interest in connection with this subject:

"Linseed Oil and Other Oils"—Ennis, p. 258.

"Oils, Fats and Waxes"—Wright & Mitchell, p. 377.

Manufacture of Inlaid Linoleum, Sci. Am. Sup. *59*, 24462.

How Linoleum and Floor Cloths Are Made. Sci. Am. 1907, *97*, 28.

Machinery For Manufacturing Linoleum. Eng'g 1897, *64*, 155.

Testing of Linoleum. Jour. Soc. Chem. Indus. 1900, *19*, 255.

"Manufacture of Varnishes"—Livache & McIntosh, Vol. I, 59.

WISCONSIN ENGINEERS CONVENE

On February 25 and 26 the Wisconsin Society of Engineers held their annual meeting in the Engineering Auditorium of the University of Wisconsin. In its last issue the WISCONSIN ENGINEER published the program for the convention, with a list of speakers and their topics. General discussions followed the presentation of each paper, the warmest of which followed the papers on the "Relation of Engineers and Contractors," and on "Beloit's Experience with Open Specifications." The convention was closed with the annual banquet at the University Club, followed by a very interesting illustrated talk by Professor Daniel W. Mead on "Flood Protection at Dayton." Over a hundred members and public officials were in attendance at the convention.

In the present number, and in the May issue, the WISCONSIN ENGINEER is publishing for the Society the papers presented at its recent convention. As far as space will permit, the discussions following these papers will also be printed.

The WISCONSIN ENGINEER does not hold itself responsible for the proceedings of the Wisconsin Society of Engineers published therein.

PRESIDENT'S ADDRESS

C. U. BOLEY
City Engineer, Sheboygan

Presented Before the Wisconsin Society of Engineers

The program committee, following custom or constitutional provision, I know not which, has placed a president's address as a preliminary to the more interesting and important business of our society. Efforts of this sort are rather out of my usual line of practice and I am thankful for the suggestion of our secretary that a *short* address be made. The agony will soon be over.

I wish also, at this time to express my appreciation of the honor conferred upon me by this society and for the untiring efforts of our able and efficient secretary in creating interest, increasing membership, and for looking after the details so nec-

essary for the success of an organization of this kind. I trust that with this increased interest and membership we may soon be able to publish a complete annual report of our doings, so that the members who are unable to be present at our regular meetings may not be deprived of all its benefits. Tax payers always pay more cheerfully when they see they are getting something for their money.

It is fitting also that we are meeting today in the halls of this great university whose influence always has been, and we trust always will be, for the promotion of the best interests of the people of the state whose name it bears.

I will not trench upon your time by a review of the engineering work of the past year, for current literature is especially efficient in keeping pace with all important progress.

In view of the fact that this society has recently acquired a substantial increase in membership, I may be pardoned for expressing a few thoughts as to its duty and purpose.

Among the chief objects, as noted in our constitution, are "The encouragement of professional intercourse between the engineers of the state, and the advancement of its members in scientific research in the various branches of engineering."

It is for such purpose we have met today and close attention and earnest consideration to the work of the session and free participation in the discussion of papers will ensure to every member valuable information and give a fraternal feeling—a closer bond of friendship for the fellows who are working along similar lines.

To supplement this service and to create a high standard for the engineering profession not only among its members but in the estimation of the profession by the public at large, this society has an important duty to perform—the duty of infusing a spirit—of high minded devotion to the profession of engineering in its relation to the complex affairs of modern civic conditions.

We are living in an age of progress, in our country, an age in which the rapid accumulation of wealth by large interest has no precedent.

Industrial development has brought into service branches of engineering unknown two decades ago. Problems of safety

sanitation, illumination, decoration, adinfinitum are being forced upon municipal officers today as never before.

The dissatisfaction of the public with the method of meeting these problems has brought about changes in the form of government of many municipalities, resulting in the various commission and city-manager plans of conducting municipal affairs now working with more or less success in our state and country, all striving to perform their duties with efficiency and dispatch. The slow process of evolution will lead to the development of a more stringent and accountable administration of public affairs. In these days of strife, unrest, and strong competition among individuals, corporations and municipalities, the engineer is confronted by many temptations.

The promoters of projects of questionable nature—the contractor in carrying out the designs and plans of corporations,—municipal or private, do not, as a rule, object to having the engineer in charge close his eyes to doubtful practice or lend his name and prestige to sanction schemes to delude and defraud the public. The engineer is too often asked to place the inspection of important work in the hands of persons whose chief qualifications are political prestige, and with the understanding that specifications are to be considered unnecessarily severe toward the party of the second part, and that due opportunity be given to escape, at least, immediate detection. That the engineering profession is living up to a high standard of performance, is shown by the growing practice of drawing from it liberally in the creating of commissions having large public interests in charge.

The engineer in the position of employee will not receive the recognition or consideration which is given to him as a member of an executive body. Even if, as a member, he has to learn much of precedent and precedure, so also will the lawyer, the doctor, or other professional man before becoming valuable in his work, and the engineer is as well fitted by training, experience and common sense as the members of any other profession.

One of the finest tributes to the engineering profession was the recent letter of President Wilson to the Civil, Mechanical, Electrical, Mining and Chemical Engineering Societies of our country asking their co-operation in the taking of a census of the in-

dustries of the United States. It points out the significance of the engineers' part in the nation's life and safety, and is meeting with gratifying response.

In the preparedness movement, the Engineering profession is awake to the gravity of the situation, as is evidenced by the attendance of more than 1,600 of their membership in an attempt to gain admission to the first military lecture in New York last week for the purpose of learning their duty to their country in military as well as civil practice.

Courses in military engineering are now being conducted in some of the larger cities in anticipation of a possible demand for such service. As the "Engineering Record" well points out in a recent issue, the present year will see something definite accomplished in the matter of preparedness, and if a call should come the country's engineers will not be found wanting.

In reference to the standards of the engineering profession I wish to call attention to the statement of Prof. C. R. Mann who is making an investigation for the Carnegie Foundation as to Engineering Education. In reply to questions sent out by him to the leading practicing engineers, he found conclusions which are not accordance with prevailing opinion. In Prof. Mann's analysis we find the following values given to the characteristics which make up the engineer:

1. Character, including integrity, responsibility, resourcefulness, initiative		41 %
2. Judgment, including common sense, scientific aptitude, perspective		17½%
3. Efficiency including thoroughness, accuracy, industry		14½%
4. Understanding of men, executive ability		14 %
		87 %
5. Knowledge of the fundamentals of Engineering science.	6%	
6. Technique of practice and of business	7%	
		13 %
		100 %

Is this estimate a correct one? May it not be true that the education of the engineer in the various arts and sciences has developed character and judgment to an extent for which is not given due credit in the estimate of the man?

If the estimate is correct do our engineering schools give due attention to the character side of education.

The growing recognition of the engineering profession in the practical affairs of today, at least seems to indicate the esteem and confidence of the public mind, and it is our duty as members to live up to the high ideals set for us by our predecessors so that we may say with Pope,

> "Honor and shame from no condition rise,
> Act well your part; for there all honor lies."

BELOIT'S EXPERIENCE WITH OPEN PAVING SPECIFICATIONS

H. W. ADAMS
Mayor of Beloit

Presented Before the Wisconsin Society of Engineers

The question of open paving specifications is one in which cities at present are taking a very real interest, and one which I believe is of great importance to them. As is likely known to many of you, in 1915 Beloit awarded one of the largest, if not the largest, paving contracts let in the state that year. The contract provided for the construction of approximately 128,000 square yards—almost nine miles—of pavement, all on a five inch concrete base, and involved a total expenditure of almost $300,000. The greater portion of the pavement laid was sheet asphalt and asphalted concrete, these two types constituting approximately 100,000 square yards, and brick the remainder.

As this was Beloit's first experience with a paving contract of such a size and our first experience with asphalt pavement it was necessary for the city to give all the phases of the paving question involved as thorough and careful investigation and study as possible; and also because the contract was a large one contractors and those handling paving matters spent a large deal of time and not a little money in endeavoring to convince the city officials of the merits of their various products and services and of the desirability of adopting the various plans and policies suggested and recommended by them. For weeks and I might say for months representatives of large paving concerns and espe-

cially the asphalt interests had their representatives in Beloit—some on the ground with great frequency and some almost constantly. We were presented with a full supply of arguments and information in support of the contentions of the various interested parties. Like most of the other cities of about Beloit's size we had not made any study of many of the questions involved in paving matters and especially those concerning asphalt pavements. We were desirous of getting as good a pavement as possible at as low a price as possible, and the conflicting opinions expressed and the contradictory evidences submitted tended to confuse to some extent those who had to pass upon the questions involved.

Inasmuch as the greater part of our pavement was either sheet asphalt or asphaltic concrete, and also because of the fact that the open or closed paving specification for Beloit contract had special significance only with reference to these forms of pavement I shall confine my remarks to the asphaltic pavement.

In order to arrive at reliable conclusions with reference to Beloit's experience with open paving specifications it is necessary to refer in a general way to several phases of Beloit's experience that are not directly connected with the question of open specifications. It should be known that Beloit employed in awarding her paving contracts the method provided by sections 59—30*a* to 959—30*j* of the revised statutes of Wisconsin instead of the old methods usually followed. These sections provide in substance that the council may decide on not less than three (3) different types of pavement, all to be laid on the concrete foundation, and then ask for bids on all types decided upon for each street. After bids have been received the property owners owning more than fifty (50) per cent of the frontage on any particular street can by petition finally decide which of the types suggested should be laid upon their street. The old method is the one by which the council itself determines a single type of pavement, and then advertises for bids on but one type for each street. Under this method the contractor knows just exactly what streets and what pavement on each street he is going to get at the time he makes his bid. Under the other method he does not. The council at first decided to follow the old method, and pave practically all the streets with sheet asphalt,

using either Trinidad or Bermudas material under closed specifications. After a long and hard fight this method and plan was changed and a compromise specification was adopted which contained all the provisions of a standard open specification similar to that recommended by the American Society of Municipal Improvements and the Society for Standardizing Paving Specifications and then there was added the following clause: "The refined asphalt to be used * * * shall be Trinidad Pitch Lake Asphalt or an asphalt that in the opinion of the public works committee is equal thereto." This was nominally a quasi open specification but in fact was an open specification for the reason that the agitation in Beloit had been such that should the bid for the Barber products have been materially higher than that of other standard products public opinion would not have permitted the awarding of the contract to the higher bidder. Under this specification all standard asphalts could compete but the tests established for each and all asphalts to meet were such that it was impossible for any undesirable or inferior asphalt to be accepted.

To most of you it is not necessary to explain that there are able and numerous advocates of closed asphalt specifications for paving and that by this is meant that only Bermudas or Trinidad asphalts are permitted to be used in paving work and that this asphalt is the property of but one concern, the Barber Asphalt Company; that there are a number of other asphalts which have obtained general recognition among experts and have been used for long periods of time throughout the United States in many important paving contracts; that the advocates of closed specifications insist that the products of the Barber Asphalt Company are of a superior quality as compared with all other asphalts and are so much more desirable and valuable to the cities that they should be used in city pavements notwithstanding the fact that the cities are obliged to pay much more for them than they are for the other asphalts; and further that these so called natural and superior asphalts cannot be produced and sold at as low a price as can the other asphalts and that therefore it is necessary and also good public policy to prevent the other asphalts from competing with those of the Barber Asphalt Company and to close the door by what is known as closed specifications; and

that should closed specifications not be adopted it would be impossible for a city which is obliged to let the contract to the lowest responsible bidder to secure these excellent materials for their pavements inasmuch as they cannot compete on an open market with the other materials. These claims were made and reiterated in Beloit for weeks in the Beloit press by advertisements, in public by the Barber representatives at the council meetings and at public hearings, and repeatedly to all of the city officials concerned. They are the foundation of the preference which has been secured in favor of these products throughout the United States at a cost to the cities of millions of dollars, this preference having existed for decades and still continuing in many places and especially in Wisconsin municipalities. Therefore upon the truth or falsity of these propositions depend the expenditure of vast sums of the public funds and what is more important depends the righteous discharge of duties by public officials. In view of these facts Beloit's experience with open asphalt paving specifications have a peculiar significance which I cannot fail to recognize nor hesitate to emphasize and to give the widest possible publicity. I believe I am not far from the truth when I say that the prevailing average bid on sheet asphalt pavement using Barber material on closed specifications for cities in this section recently has not been far from $1.80 per square yard. I have seen bids under which contracts have been awarded in this state since the Beloit contracts were let in which the figures exceed the amount given by the same contractors right here in Wisconsin.

Having these vital facts and claims in mind I now pass to consideration of the actual figure obtained at the Beloit bidding on April 10 last. The bids on sheet asphalt were as follows:

California, per square yard	$1.53
Texico, per square yard	1.68
Aztec, per square yard	1.36
Mexican, per square yard	$1.28 and 1.48
Trinidad, per square yard	1.37

The bids on asphaltic concrete were:

Aztec, per square yard	$1.27, 1.32 and 1.50
Mexican, per square yard	1.18, 1.28 and 1.33
Magnolia, per square yard	1.43

California, per square yard	1.38
Texico, per square yard	1.33
Trinidad, per square yard	1.22

The cost of paving to the owner of a fifty-foot lot on a twenty-six-foot driveway was substantially as follows:

Asphaltic concrete, Trinidad	$94.50
Sheet asphalt	103.50
Concrete	112.00
Tarvia	105.50

The bid on sheet asphalt using the Trinidad material, was so low that we could obtain a sheet asphalt street with the Barber material, for $8.50 a lot cheaper than we could a Portland Cement concrete street and $2 a lot cheaper than we could obtain a Tarvia street. If figures had been prepared showing the cost per lot for a sheet asphalt or asphaltic concrete, using Aztec, Texico, California or Magnolia, they would in each case, without even considering the bids on excavation or curb or gutter, have materially exceeded the cost of the same pavement using Trinidad asphalt. In every case, no matter what asphalt is used, the Barber bid was materially below that of any other bidder. As appears from the tables I have given, the contract both for sheet asphalt and asphaltic concrete were awarded to the White Construction Company, at $1.37 per square yard for the sheet asphalt, using Trinidad, and $1.22 per square yard for the asphaltic concrete, using the same material.

BIDS ON EXCAVATION

Sensational as these figures are, they do not tell all the story. In order to grasp the full significance of the bid of the White Construction Company, which to say the least, has the most friendly and intimate relationship with the Barber Asphalt Company, it is necessary to study the bids on the excavating and the combined concrete curb and gutter. The average bid of the nineteen submitted for excavation was thirty-nine and one-sixth cents per cubic yard. Of the nineteen bids, fifteen were thirty-five cents per cubic yard or more. George Welch, a Beloit contractor, who was awarded the contract for all the brick pavement, got it in a bid of thirty-eight cents a cubic yard for the excavation. Yet the White Construction Company bid twenty-

five cents per cubic yard, or fourteen cents below the average bid, and thirteen cents below the successful bidder on the brick pavement.

FIGURES ON CURB AND GUTTER

The figures on the combined curb and gutter are not less interesting and instructive. The average bid was forty-seven and a half cents per lineal foot. Of the nineteen bids, fourteen were forty-five cents or over and eight were fifty cents or over. George Welch got the contract on a bid of forty-eight cents per lineal foot. The successful bid of the White Construction Company was thirty cents per lineal foot, or seventeen and a half cents under the average bid, and eighteen cents per lineal foot under that of the successful bidder for the brick pavement. Where nineteen of the leading contractors of this section of the country are all figuring on the same job, and one of the most successful and best known and most responsible financially of the bidders submits figures, such as I have just given which are so low as compared with the other able contractors' bids, as the ones in question are, a careful student of all the conditions and circumstances connected with the public work in question and especially of the bidding sheet, is almost forced to an explanation of these figures by saying that the successful bid was not prepared upon the same basis and theory and with the same motives and ends in view that the other bids were prepared, or that bids ordinarily are prepared.

DISTRIBUTION OF COSTS

After long and careful consideration, I make the statement that it is my opinion that the successful bid on the asphalt pavements made by the White Construction Company was prepared by distributing the total amount for which this concern by ordinary methods determined that it could do the work in question, among the three sub-divisions of the total bid—that is, the excavation curb and gutter and the paving proper, so as to make the bid on the paving division as high as possible, and that the reason for such method and distribution was to prevent in so far as possible, the claims of the Barber Asphalt Company upon which they base and by which they justify their demand for

closed specifications, from being completely discredited and their whole foundation upon which their preference, which means hundreds of thousands of dollars to them rests, from being entirely knocked from under them. It is plain however that in order to land this large contract, in spite of all their skilful manipulation of the figures when forced to do so, they have created facts and submitted figures by which they virtually answer their own arguments and disprove their fundamental claims. They proved false their repeated positive assertions made at Beloit, and also made throughout the United States that they could not and would not come in and bid on an open standard specification, by voluntarily participating in the bidding. They demonstrated the untruthfulness of their statement that Trinidad or Bermudas asphalt cannot compete with other standard asphalt, for the reason that it costs more, by submitting bids on Trinidad asphalt materially lower than those of any other standard form of asphalt, and even lower than that of tarvia. They outdistanced their nearest competitor by about $12,000 on the total contract. These facts I believe are of great practical importance to the cities of this state.

HOW BIDS WERE OBTAINED

The question naturally arises as to how these phenomenal bids were obtained. Some have called attention to the fact that last year was an off year for contractors, that little work was to be had and that wages and prices of material were low. As to the prices of material and labor, the statement is undoubtedly true to some extent, but because of this very condition it is not at all certain that the usual amount of public improvement by municipalities was not under way; as a matter of fact, many municipalities availed themselves of these favorable conditions and let contracts for street improvements and other public work which would not have been let for some time were it not for this condition. If the bids submitted in other cities in this section for paving contracts last year are compared with those submitted at Beloit, it will be seen that while the bids in the other cities may be slightly lower than those obtained in past years, they are greatly in excess of those obtained at Beloit and our figures must be accounted for upon some other theory.

NOT EXPLAINED BY NEARNESS OF MATERIALS

The fact that Beloit has large deposits of sand and gravel, but a short distance from the city limits, is also a fact which has some influence in securing from all bidders, general low costs. This factor however is not as important as some have thought or as might be expected. This condition would of course merely affect the freight rate on the sand and gravel used in the work. None of the Beloit pits have a freight rate of less than $10 a car into the city. The difference between the rate from the Beloit pits to the city of Beloit and from the same pits to Madison is as I recollect, twenty-four cents a cubic yard of three thousand pounds. The total amount it would be possible to save on this contract involving about $200,000 because of the proximity of the sand and gravel, would as a rough estimate, be from five thousand to six thousand dollars on the asphalt and asphaltic concrete streets. This factor therefore, is far from explaining the general low bid.

The size of the job has been assigned as one of the chief reasons for the low bids, and this at first appealed to me as a very important consideration. Examination of the bidding sheet however shows that the contractors made little or no difference on their bids on the large or the small jobs.

ANALYSIS OF BID SHEET

The bid sheet is an instructive piece of paper. Next to the low bids, the most surprising disclosure is the small difference in most cases between the bids by the same contractors on the three different quantities. Seventeen out of the nineteen bidders made no difference whatever on the excavation for the three quantities. Thirteen of the nineteen bidders made absolutely no difference on the different quantities of curb and gutter; of the six who did the difference was small; four out of the six made a reduction of but two cents a foot for the largest quantity as compared to the next largest.

The same is true to almost if not as great an extent with reference to the bids on the paving proper. Of the five contractors bidding on all three quantities of sheet asphalt and asphaltic concrete, three made absolutely no difference between the three quantities. We had fourteen bidders on sheet asphalt and

asphaltic concrete; of these, as already stated, five bid on all three quantities, five on only the twenty-five thousand square yards or over and four on the two largest quantities only. Of the five that bid on the two largest quantities, two made no difference whatever and of the others, one was lower five cents a yard, and the other six cents on the large quantity. We would of course expect to find the greatest difference between the bids on the various quantities of sheet asphalt or asphaltic concrete because of the great expense of moving the asphalt plant and other fixed overhead charges, not present in the other class of work, but even here, you find very little difference except in the bids of the successful bidder, the White Construction Company.

DIFFERENCE ON BRICK NEGLIGIBLE

On the brick, the difference between the three quantities was so slight as to be almost negligible; the contractor who was awarded the work of laying the brick pavement, George Welch of our own city, made no reduction whatever for the larger quantities. We can therefore say that the objection that the contractor does not know whether he will get the large or small contract, or even any at all, need not and does not affect the successful use of the method in question, and that many of the contractors make no difference in their bids on the large and small quantities.

NEW METHOD RESPONSIBLE

I now come to another factor which I am convinced was more potent than any yet mentioned and that is, the adoption of the new method of awarding the contract provided for in Sections 959—30*a* to 959—30*j* of our statutes. This method got a much larger number of contractors interested than would have been interested had the old method been employed and only sheet asphalt contractors and the brick contractors called on to bid. As it was, we had bidders on creosoted wood blocks, brick, sheet asphalt, asphaltic concrete, Portland cement concrete, and tar macadam. No contractor knew when he submitted a bid whether a street must be paved with his material, or some other material, as this was left to the property owners after the bids were opened. The brick man knew that if he did not get his price

down as low as possible, and near that of the sheet asphalt, or concrete street, that the property owners would turn down his brick pavement because of the large difference in cost and adopt one of the other forms. The concrete man felt the same way with reference to asphalt and the asphalt man felt the same way with reference to concrete and also tarvia, etc. Thus, an intense competition was established, not only between bidders on asphalt streets, but between the bidders on the asphalt streets and the bidders on the tarvia and concrete streets, and so on. This undoubtedly had some effect on the general low prices and saved the city considerable money.

But what I have been saying applies to all types of pavement upon which we called for bids and has no special reference to the bids on sheet asphalt or asphaltic concrete and affected all bidders on both of these types of pavements alike. Therefore, what I have said with reference to the causes of the low general bids in no way weakens, or qualifies what I have previously said concerning the bearing of the bids upon the claims and practices of the Barber Asphalt Company.

OPEN ASPHALT SPECIFICATIONS

What I am now about to discuss has a more direct bearing upon the special statement of the subject which has been assigned to me, although I do not believe that the subject assigned would be properly treated without having discussed the various phases of our paving experience. I now come to what I consider the chief factor in the production of the remarkably low bids on our asphalt pavement, and that is the opening of the asphalt specifications.

THE PRINCIPLE FUNDAMENTAL

The principle which was involved in the contest at Beloit over the opening of the asphalt specifications lies at the foundation of most of the large purchases and contracts for public work made by municipalities. It is a principle that is receiving considerable attention at the present time, but which is not thoroughly understand by many, and concerning which many others have not formulated any definite ideas or conclusions.

The purpose or end to be sought in each case, is the obtaining of as good an article or piece of work as the necessities of the

case require and should have, for the least outlay and without any improper or corrupt act on behalf of the officials handling the transaction. There are therefore, three elements involved: First, quality and efficiency; second, economy; and third, governmental integrity. These three elements must constantly be kept clearly in mind when discussing this subject and the position one takes upon this question, will largely be determined by the relative value or importance assigned to these elements.

I believe there are few if any municipal officers who would favor either of the extreme positions that can be taken on this subject and we therefore have one principle upon which we are practically all agreed and that is that the authority to make the purchases or let contracts for articles or materials should in all cases neither be unrestricted as to specifications or in all cases restricted. Some purchases are to be made and some contracts let by designating one particular article or material by name, thus excluding all other articles or materials; in other cases, general specifications should be drawn up, setting proper requirements which if met by the products or goods of any one, should be accepted as being the determining factor in the decision.

PRACTICE A QUESTION OF MEN

Between these two extremes, there will be and is a wide difference of opinion and it is here that trouble arises and that we have few well settled rules to guide us. A rule or policy that would produce desirable results in one city with a given set of officials will produce undesirable results in another city with another set of officers or even in the first city should its officials be changed. Here, as in all other governmental matters, it is largely a question of men, but because of this lack of uniformity in human nature, it is necessary to have some recognized rule that shall be uniform and operate on all men so as to make their action in this one particular uniform.

It has been, and in most cases still is, the policy of the law of this state in the letting of contracts for public work to require detailed plans and specifications to be prepared, general bids to be asked for and the work to be let to the lowest responsible

bidder. The specifications I just mentioned, and other specifications of a similar nature, take away this safeguard and protection, and empower the officers to let bids to the highest, rather than to the lowest bidder. The principle underlying open specifications has for its object public honesty and integrity—the elimination or prevention of graft. It is true that at times this rule or principle may conflict with efficiency, or quality, or possibly economy, but is equally true that what it is trying to eliminate—corruption—also conflicts with both efficiency, or quality, and economy, and what is more, tends to undermine the very foundations of municipal government.

HONESTY OF PRIME IMPORTANCE

Dishonesty or corruption in municipal or any other office knows not and respects not either economy, quality or efficiency, but preys upon and destroys all three. I regard public honesty and integrity as of greater importance and value than a perfect street pavement, or the best type of garbage wagon. I prefer (if it were necessary, which I do not think it is in most cases) a street pavement that wears but ten years, secured by a method which involved no corruption of public or private morals, to a pavement which lasts for fifteen years secured at a somewhat higher price and by methods which corrupt both the government and the individual.

The poor street is a local misfortune but the corruption of our city government is a public calamity; the first is temporary only, the second is permanent. The loss or injury by the first is calculable in dollars and cents and can be in a very short period of time entirely remedied and removed by financial means; the second cannot be valued in dollars and cents and is an injury not to dirt, houses, or streets, but to character, life, and government. It seems to me therefore that the argument in favor of open specifications is much more convincing than that in favor of a too great power in public officials, manifested by closed specifications. If we err at all, it would seem that we should err on the side of public integrity, even though to obtain it we may occasionally sacrifice to some extent economy, quality and efficiency.

OPEN SPECIFICATIONS GOOD POLICY

I have made this seeming digression as an introduction to what I am to say in support of my contention that it is safe, and wise, and good public policy to open specifications for asphalt pavements. The experience of Beloit which I have endeavored to put before you, it seems to me, is in itself the strongest argument of a concrete nature that could be offered in support of this contention. There is, however, much additional information which supports the facts in the Beloit case, and which in reality was the force which caused the opening of the Beloit specifications so that the facts which I am about to present have been vindicated and received added authority by the Beloit experience for which they are largely responsible.

Before forming my opinion on the claims of the Barber people, that public policy required municipalities to close their asphalt specifications to all asphalt except Trinidad and Bermudas, I made an independent investigation of the claims and gave the subject as much study as my limited time would permit. I addressed letters to a number of our principal cities asking what the experience of each city showed as to the comparative merits of the Barber asphalts and other concerns; whether the city had open or closed specifications; and whether the Barber Company would compete with other concerns on open asphalt specifications.

I received replies from the following cities:

Denver, Colo.	Columbia, S. C.
Washington, D. C.	New Orleans, La.
St. Paul, Minn.	Philadelphia, Pa.
Minneapolis, Minn.	Rockford, Ill.
Duluth, Minn.	Chicago, Ill.
Pittsburg, Pa.	Omaha, Neb.
Hartford, Conn.	Baltimore, Md.

In all of these cities closed specifications on asphalt pavements have been abandoned and contracts are let on open specifications.

I also learned that among others the following cities had abandoned closed specifications:

New York City	Elizabeth, N. J.
Scranton, Pa.	Norfolk, Va.
Erie, Pa.	Raleigh, N. C.
Chester, Pa.	Charlotte, N. C.

Buffalo, N. Y.	Atlanta, Ga.
Rochester, N. Y.	Cincinnati, O.
Cleveland, Ohio	Greensboro, N. C.
Toronto, Ont.	Providence, R. I.
Syracuse, N. Y.	Wilkes-Barre, Pa.
Utica, N. Y.	Harrisburgh, Pa.
Albany, N. Y.	Birmingham, Ala.
Newark, N. J.	Schenectady, N. Y.
Paterson, N. J.	New Haven, Conn.
Louisville, Ky.	Jacksonville, Fla.
Hamilton, Ont.	Atlantic, City, N. J.
Trenton, N. J.	Charlestown, W. Va.

I select the following quotations from the various letters I received:

Prof. Leonard S. Smith, a well known expert on paving, of the University of Wisconsin, writes in part as follows:

"The claim of the Barber Asphalt Company that they cannot compete with other companies with open specifications is ridiculous and only a bluff. That company did compete last year in Chicago and built many miles of asphalt pavement at less than $1.70 on six inches of concrete foundation, while Milwaukee with the same closed specifications as they wish you to have, paid $2.00 per square yard."

Assistant engineer of the city and county of Denver:

"This city has laid a considerable quantity of both the asphalts and has good results in each case."

Mayor of Minneapolis:

"We have had little experience with oil asphalt but it seems to compare favorably with 'natural.'"

Commissioner of public property, New Orleans, La.:

"We now use the manufactured asphalt exclusively for our municipal repair plant which has charge of the maintenance for all asphalt streets. We have made numerous chemical tests of the manufactured asphalt and in my opinion I consider it equal in quality to the Barber's 'natural' asphalt. We do consider the manufactured asphalt equal to the natural for general paving purposes."

Chairman and Construction Engineer R. Keith Compton, Baltimore, Md.:

"Our experience in this city shows that when properly han-

dled there is practically no difference between the so-called 'natural' and the so-called 'artificial' or oil asphalt.''

City engineer of Columbia, South Carolina:

''We have used both natural and so-called artificial asphalt in our bituminous paving in the city. This work includes Bermudas and Trinidad known as 'natural' asphalt and also Mexican, Texas and California asphalt which are represented by the 'natural' asphalt paving promoters as the 'artificial' asphalt. Up to the present time we have found no difference whatever in the wearing qualities of the two asphalts. Our experience shows that the representatives of the Barber or 'natural' asphalt will compete for work under open specifications when they find they cannot get closed specifications.''

Superintendent of department of public works, Pittsburg, Pa.:

''We have laid asphalt pavements of both 'natural' and 'artificial' asphalt. The asphalt used by the city repair plant for the past few years has been artificial while the asphalt laid by the contract is the natural asphalt or Trinidad. Equally good pavements can be laid with either kind of asphalt but artificial asphalt requires greater skill in its preparation.''

The Barber Asphalt Company do not use any Trinidad or Bermudas asphalt west of the Rockies, but themselves recommend and use California asphalt from the Baker oil fields. Up to the first of January, 1915, more than fifteen million square yards of asphalt using this material had been laid in this section of the country. The city of Washington would no longer permit Trinidad asphalt to be used on its streets.

CONCLUSIONS

That the claims of the Barber Asphalt Company that the cities of the country should give either Trinidad or Bermudas asphalt an advantage or preference by closing the specifications and compelling the cities to pay large sums for either of these asphalts in excess of what they pay for other recognized asphalts is not based upon facts and proof, and is unwarranted.

THE RELATION OF ENGINEERS AND CONTRACTORS

J. C. PINNEY, JR.
Superintendent of Bridges and Public Buildings, Milwaukee

Presented Before the Wisconsin Society of Engineers

In considering the relations of an engineer with a contractor we must first look to see the relative positions held by each. The engineer, a professional man, is usually the authorized representative of what we may call the "Purchaser," while the contractor, also often a professional man, is the "Seller." The relations between the two, then, are, broadly speaking the relations that exist between buyer and seller. The buyer expects and should receive one hundred cents worth of service for every dollar he pays, and the seller expects and should receive a dollar for every one hundred cents worth of service he gives. When this condition obtains there should be no friction between the two parties. Conceding this, then, as the ultimate object to be obtained, the subject before us this afternoon consists of the requirements from first to last to assure the existence of amicable relations.

The relations between engineers and contractors may be considered as extending over three distinct periods or operations, viz:—

1st. The preparation of plans and specifications by the engineer.

2nd. The estimating by the contractor on the work covered by these plans and specifications, together with his bid on the same and the letting of the contract; and

3rd. The construction or performance of the work called for and agreed upon.

These periods, though distinct in point of time, and also constituting distinct steps in the subject at hand, are by no means independent of each other. As a matter of fact, they are very closely interwoven, and the actual construction which is in reality the giving a hundred cents worth of service for a dollar received, depends, I might say, almost entirely, upon the proper

NOTE—The presentation of this subject from the standpoint of the contractor will be given by Geo. Stanchfield in May issue.

weight and care being given to the two preceding steps. The same may be said of the second step wherein the contractor cannot intelligently estimate the amount and cost of the work unless the engineer has properly and with due care prepared his plans and specifications to furnish the contractor the necessary information.

It will perhaps be well to consider these three steps separately, and see what and how each one should contribute to amicable relations between engineer and contractor, for this is, I believe the real object of our discussion of this subject.

1st. Plans and specifications.

Briefly, the engineer through his plans and specifications informs the various bidders what he wants done, how he wants it done, and when he wants it done. In preparing these vehicles of information, the engineer in his professional capacity, assumes the responsibility of not merely designing a structure which will have ample provisions for its estimated requirements but also of imparting to the contractor definite, concise and detailed information as to the amount of materials needed, the exact kind of material needed, the general method of placing (not detailed methods of construction), and the method of determining whether or not the contractor is furnishing what is desired. Assuming, as he does, that if the proper amount and kind of materials are placed according to his design, the structure will meet its requirements, it is very strictly the duty of the engineer to be most scrupulously particular to impart the fullest information of his requirements to the contractor. Otherwise the contractor cannot intelligently determine what the proper cost will be, and he must assume a risk which is not proper for him to assume. The contractor in this respect is entirely dependent upon the information given by the engineer through his plans and specifications.

2nd. Estimating and bidding.

Having at hand full information from the engineer as to what is required, the contractor has to determine the exact quantities and kinds of materials needed, where and at what cost they can be purchased, etc. If he has received proper information from the engineer, this is an easy task. In addition to these material costs, there are various other costs which the contractor must de-

termine from information outside of the engineer's plans and specifications. Among these are such as cost of hauling, labor conditions, and natural conditions at the site. These are items which the contractor in his professional capacity assumes the responsibility of correctly determining, and he in turn imparts this information to the engineer in the form of his proposal or bid.

So far the relations between the two have probably not been disturbed by a ripple, whether or not the engineer has furnished proper information, and whether or not the contractor has properly informed himself. As a matter of fact the relations between contractor and engineer are in the embryo and we arrive at what I have chosen to call the

3rd. Period, the actual construction. It is here that the engineer and contractor must be in constant touch with each other and work side by side. It is here that the faults and shortcomings of the engineer's plans and specifications, and the contractor's estimating will make themselves known. It is here that the engineer will be called upon to interpret his specifications and it is here that the contractor will be called upon to prove his estimating ability.

In interpreting his plans and specifications the engineer, who of necessity has final authority, must view them from two points. What has he actually said in his specifications as to the requirements, and what had he in mind when he wrote the specification? In other words, he must first assure himself as to whether or not he clearly and concisely informed the contractor through his plans and specifications just what was to be required. Do the specifications give the information as to what tests the engineer may require in order to assure himself that the materials meet the requirements? If not has he the right to require such tests? I do not mean to imply that the exact nature of every little test should be stated in the specifications, but I do maintain that the specification should be so drawn up that the contractor, if he is capable of reading and understanding specifications, should have, before bidding, a clear idea of what tests the materials may reasonably be expected to pass. In interpreting his specifications and passing upon the quality of materials, I hold that the engineer should be guided as follows:

1st. Assure himself that all material accepted meets the re-

quirements of its particular use in the structure whether or not these requirements are fully covered in the specifications, and

2nd. Determine whether or not the specifications can reasonably be interpreted as requiring this particular grade of material. If not, the grade of material as required by the nature of the structure itself should govern and reasonable adjustments made to cover any extra cost to the contractor.

It doubtless happens many times that the engineer finds certain things are not as clearly specified as they should be, and that a grade of material or a class of work which will comply with the specifications, especially if strictly interpreted, will not fully meet the requirements which he had in mind at the time of designing. Perhaps it was a stenographic error which he failed to detect, or perhaps it was an error by the engineer himself. It matters little whose error it was. The engineer in all fairness to himself and his client should have the proper material used, and in all fairness to the contractor he should make due allowance for the discrepancy.

In this connection I might also add that there are many little things which seem like mole hills, but which turn out to be mountains when the time for interpretation arrives, and which can well be covered by a few words of explanation. For example: An engineer might specify "Clean, sharp sand, etc." When the acceptance of the sand comes up the question arises, "What is meant by *clean* sand?" The contractor may have bid with the intention of using a bank sand near by which contained 5 or 6% of loam, and when he comes to use it he finds that the engineer insists on not over 2 or 3% of loam content Again an engineer may specify a boiler of a certain horse power capacity. What will he interpret as a boiler horse power? Ten square feet of heating surface, or an equivalent evaporation of 34 pounds of water per hour? In either of these cases a single sentence would tell the bidder beyond any question, just what is wanted and might save worlds of trouble.

Furthermore, I believe the engineer should in his specifications give a clear idea as to what tests he will require and as to how they are to be made. This will furnish the contractor a more concise and clearer idea of the exact requirements.

It might be well to add here a few words on the conducting of

the various tests. There is no doubt that the most agreeable relations will exist between the contractor and engineer if the latter will give the former ample opportunity to be represented at the making of all tests, and be apprised of the results of such tests. These are usually the final determinations as to whether or not the contractor is living up to his agreement and he should in all fairness be represented when they are made if he so desires.

There is one more subject to be considered under construction, which is to my mind of considerable importance, the subject of alterations.

I believe it is safe to say that few structures of any magnitude are completed in exact conformity with the original plans. As actual construction progresses, various reasons appear which make certain changes in the plans or methods of construction expedient. Such reasons may arise from two general sources. 1st. The engineer may deem it expedient to make certain alterations in the plans because of new conditions arising since the original plans were drawn or, 2nd the contractor may request certain alterations which would lessen the cost to him or expedite the work.

Whenever an alteration appears to be advisable, no matter from which source it may arise, the engineer should take it up and determine

1st. Are there sufficient reasons to warrant the change? In answering this question he should inform himself of all the circumstances connected with the reasons for the changes.

2nd. How do the proposed alterations affect the structure itself? The engineer should determine as far as possible the answer to this question from all sides in order to reach a satisfactory conclusion. He must determine the effect of such change on the design of the structure, or upon the ability of the structure to fulfill its ultimate purpose. If it will add to the ultimate value or use of the structure, the change is evidently desirable. If it appears to impair the structure in any way, it is evidently undesirable.

3rd. The cost of such change. After determining the advisability of an alteration from the technical point of view, the engineer should carefully determine the additional cost if any, of

making such alteration. In determining this he should work in conjunction with the contractor, as there are often many items with which he may not be any too familiar. There will be little if any difficulty for the two parties to arrive at a satisfactory agreement, and such an agreement should be reached before hand whether it adds to or subtracts from the cost to the contractor.

There is a rut in the line of alterations which I believe both engineers and contractors should avoid, that is the custom of passing up various alterations without determining the actual change in cost with the idea that they can be balanced by a "give and take" method. There are of course many little changes which are not worth the time necessary to carefully consider, but all alterations aside from these very minor ones, should be given a financial consideration, and if this is done, the "give and take" method can be applied satisfactorily to all concerned.

Before leaving the subject of alterations, there are a few remarks in general that I feel should be made. Most engineers and contractors as well, I believe, will agree that alterations in the design of a structure should be made only when their expediency is very plain. They should be reduced to a minimum. An alteration causes considerable annoyance and work on the part of the engineer, and it often causes considerable annoyance and an intangible cost to the contractor in changing, to a slight extent it may be, a definite program which he has laid out.

PAYMENTS

There is one item which I have not as yet mentioned but concerning which I feel full information should be given to the prospective bidders. That is the item of payments. The successful contractor today must take into account every item of expense connected with the work upon which he is bidding. One of these items is the interest on the moneys he is required to forward until he receives a payment. If he is reasonably certain of when and how payments are to be made, he can present a more intelligent proposal and a more equitable price for the work. I am of the opinion that payments should be made at certain predetermined intervals, either interval of time or of the progress of the work. If a certain part of the final payment is

to be retained for a period after the completion of the work, such should be stated in the bidder's instructions.

CONCLUSION

In conclusion I would say that probably the real subject I have dealt with is not so much the actual relations which exist between the engineer and the contractor, but rather how these relations can be made as agreeable and pleasant as possible and kept there without sacrificing the interests of the owner or the terms of the contract, and without requiring undue or unfair concessions from the contractor. I have endeavored to present to the society the way I think will accomplish this end. In doing this I have tried to present what in my opinion is the proper attitude for the engineer to assume, leaving the contractor's side to be presented by one of their members. Briefly the points I have intended to make are: The engineer should take every precaution in the preparation of his plans and specifications to assure himself that every item of information possible is given the contractor in order that an intelligent and fair bid may be submitted. The engineer should interpret the specifications and plans in the light of what they actually say or show, and if this is different from what he intended or from what will produce the structure he originally designed, due allowance should be made for such discrepancy. In all matters of tests and alterations the engineer should take the contractor into his confidence, and treat the same jointly with him. With the engineer following this program, which should not require him to sacrifice any of his client's interests, I am firmly convinced that so far as he has control, his relations with the contractor will be of the pleasantest.

Volume 20 **Founded 1890** **Number 7**

The Wisconsin Engineer

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

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.

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.

EDITORIAL

A few weeks ago the senior class of one of the engineering departments began the study of one of the most important of the subjects offered in that department. The subject being large, and the time available short, opportunity was given the class to choose between the assignment of a special phase to each member, to be of his own selection, and later to be reported upon and discussed in class; or,—the alternative—to do the regular class work leaving out such supplementary work.

The class voted. One senior desired the extra work.

Of course the incident does not directly reflect upon the institution. In either event the work is prescribed to maintain the same thorough standard. But it seriously points out one thing: students are not after the education, but the credit; for in due season, will not the minimum number of credits graduate them?

Next to fresh air, education is the freest thing this country affords. Unfortunately, however, it requires a special brand of glue to attach the same. The institution affords the very best in education, and some masterly hints on how to apply the glue. But it will not furnish the glue; neither will it smear it on. Result: in most cases, only that glue is used which is good for five months. After that, who cares, for has not the credit been justly earned?

Three little birds in a row
Sat musing.
A squirrel passed near that place,
Gathering his store
For the winter months.
Then did the little birds nudge each other.
They said, "He thinks he is wise."
And they fixed their faces to laugh;
With wry countenances
They regarded him,
These three little birds in a row.

* * *

At this time of year there seems to be a noticeable decrease in interest in class work. The memory of the strenuous finish of the first semester is not so fresh, and the good resolutions we made at the start of the second are beginning to seem rather unnecessary; why worry about something that is not rushing, we will have lots of time before the end of the semester. Some, especially among the seniors, are beginning to feel that this is only a sham battle; we are in a hurry to get away from these mock problems and attack the real problems; but we forget that if we find these mock problems distasteful and leave them undone, we are weakening ourselves for any future problems we may meet. What would we think of an athlete who refused to take any interest in preliminary training? Are we not putting our-

selves in the same position, are we not going "stale?" Let us get back in training with a show of the enthusiasm that wins, so that we may feel that we are in shape to tackle anything that comes along, and make it *go*.

* * *

The long waited and watched-for minstrels are a thing of the past. There were many disappointments, many unforeseen difficulties, many obstacles, but the committee was composed of the right kind of men; they met each reverse with a little more of the real "spirit" and made things hum. From the beginning of the advertising campaign, the snappy posters held the attention of all, the "wise gink" told of the wonders in store, St. Patrick and his followers were greeted with enthusiasm, and the "big show" itself was a success in all ways.

ALUMNI NOTES

F. D. Bickel c '15, who was formerly assistant to the city engineer of Beloit, Wis., is now with the Oliver Mining Company, 101 Sellers St., Hibbing, Minn. We were also told that he was married before he took the new position.

L. B. Orr e '09, who has for the last six years farmed near Bagley, Wis., is now back at the University working for his electrical engineering degree.

K. W. Erikson ch '13, is employed with the Markor Galvanizing Company of Evanston, Ill.

R. S. Magatagan ch '15½, is with the Union Carbide Company at their Sault Ste. Marie, Mich., Works.

H. F. Zabel ch '13, is at Bloomfield, N. J., with the Westinghouse Lamp Company.

R. S. Peotter c '05, C. E. '09, who was formerly Managing Engineer for the Knoxville Power Company, Alcoa, Tenn., is now with the Aluminum Company of America, at Paramaribo, Dutch Guiana, South America.

W. U. Murrish E '11, is now local manager for the Sierra & San Francisco Power Company at Tracey, Cal.

O. O. Kuentz m '08, who was formerly draftsman on the Isthmian Canal Commission, Culebra, Panama, is now second lieutenant in the United States Army, in care of the Adjutant-General at Washington, D. C.

S. J. Shu e '13, who recently was a student at the Massachussetts Institute of Technology, Boston, Mass., is now Director of the Waterways Engineering College, at Nanking, China.

J. E. Lauderdale e '11, who was formerly with the National X-Ray Company, is now illuminating engineer for the Burdorf-Brecher Company, 435 W. Jefferson Street, Louisville, Ky.

We received a short time ago a very interesting letter from Earl E. Hunner, General Superintendent of the Great Northern Iron Ore Properties. It reads as follows:

"Up to a year ago my work was largely a matter of examin-

ing and reporting on mines and laying out of operating plans; but a year ago last November I was given a chance to carry out such plans. We had about 25 men in our inspection department inspecting operations carried on by the steel corporation before the winding up of the Hill lease, and inspecting the operations of many independent companies operating our properties. In a month's time we raised this number to about 1,000 employes, took over several operating mines, and started at once on the development of others. At present we are in a position to ship from thirteen different properties and if called upon to do so at any time we can ship a very respectable tonnage. The work of operating has proven more interesting than the planning. I think the most interesting part of it all lies in watching the development of men. When we started out the matter of organization was left entirely to myself. I had some ideas relative to this matter and sufficient nerve to carry them out with the result that before long we were recognized as a kindergarten organization in that we only had one man older than myself holding what might be called a responsible position. I have been on the Range since 1902 and when my chance came to pick out a crack organization through constant traveling over the field I was in a position to know the men who were getting results, and during the past year I think there is no question but that our work was carried on cheaper than any other company's operations in that field, notwithstanding the fact that our organization was young as a working unit and the fellows in the organization were not as well acquainted or used to each other as they might be."

* * *

Invitations have been sent out by Mr. and Mrs. Joseph M. Boyd, of this city, announcing the marriage of their daughter, Choral, to Maynard A. Cook, of Alma, Mich., on Thursday, March 23. Mr. Cook received his professional degree in mining in 1914. He is at present employed by Sloan-Huddle, Fenstel and Freeman, consulting engineers of this city.

* * *

The 1916 alumni directory has gone to press. It is the third attempt to publish a reliable alumni directory of the College of Engineering. Needless to say, it was not an easy task to collect

and arrange the information; but it is believed that the usefulness of the directory abundantly justifies the work involved.

A small percentage of the alumni have not responded after many calls. We are sorry that we could not locate these men. We herewith publish the list, and ask you to examine it and give us any information you may have concerning these alumni:

Ball, W. C. c '11.
Benson, J. W. m '14½.
Bertke, W. A. e '06.
Bleyer, C. F. m '07.
Carlsen, C. J. m '96
Clayton, H. B. c '15½.
Cleary, J. E. ch '07.
Coleman, A. F. m '09.
Crane, E. W. e '95.
Curwen, W. H. ch '11.
Dale, D. P. c '11.
Daniels, P. H. c '10.
Dunnewald, P. W. c '13.
Estberg, H. C. e '07.
Evans, E. M. c '94.
Gibbert, A. L. m '15.
Gibson, L. E. '10.
Gregerson, L. T. c '95.
Grimmer, E. W. c '14.
Hain, J. C. c '93—C. E. '05.
Hale, M. C. c '15.
Handy, E. H. e '11.
Hanson, H. O. e '99.
Hanson, W. S. m '95.
Hitchcock, F. A. c '10.
Hoffman F. J. c '11.
Johnson, Godfrey e '14.
Larson, L. M. c '09.
Libby, L. M. e '07.
Lutze, H. F. e '08.
Maurer, R. E. m '14.
Mengel, F. F. c '11½.
Merriam, H. N. c '98.
Noyes, E. C. c '13.
Olson, C. A. E '15.
Parker, H. R. ch '15.
Reynolds, T. M. c '12.
Richter, E. R. g '07—M. E. '15.
Rosenow, E. E. m '14.
Saigh, N. A. c '15½.
Schneider, A. G. ch '13.
Schuler, F. J. m '08.
Seyton, H. J. e '05.
Sherron, F. J. g '05.
Smeaton, C. A. e '07.
Smith, J. R. m '05.
Staehle, P. M. e '12.
Storkey, H. N. c '13.
St. George, A. B. e '09.
Stoddard, L. L. e '13.
Sturgeon, E. T. c '12.
Taylor, H. C. 11½—C. E. '12.
Terven, L. A. e '02.
Waite, J. H. c '10.
Wehausen, G. W. e '08.
Welsch, H. L. e '10.
Woodman, E. E., C. E. '80.
Zimmerman, F. R. m '12.

Clark M. Osterheld e '14, superintendent of the Stoughton municipal electric light plant, was married to Miss Dora Miller, also a recent graduate of the university, the latter part of last month. The ceremony was performed by the Rev. J. A. Davidson and took place at the home of the bride's parents on Madison street. The "newlyweds" took a wedding trip to New Orleans.

R. H. Baker ch '15, is instructor in chemistry at the University of Cincinnati, Cincinnati, O..

W. R. Lacey ch '15, resigned his position with the Waukesha Gas & Electric Co., and is now with the Rockford Gas. Co., Rockford, Ill.

J. Trantin ch '15, who was with the Illinois Steel Co., resigned his position with that firm, and is now with the National Electric Company at Chicago, Ill.

A. J. Grenfell ch '15, is now with the Mineral Point Zinc Co., Depue, Ill.

A. J. Stirn ch '15, is now with the Milwaukee Coke & Gas Co., Milwaukee.

E. C. Wild, '06, formerly engineer on the Yazoo-Coldwater Drainage Project, is now with the Morgan Engineering Company at Memphis, Tenn.

The Knoxville Power Company is bringing the much considered plans of a new Hydraulic Power Plant at Alcoa, Blount County, Tenn., into fruition. In a communication from W. C. Penn, the opportunity for Wisconsin men is made evident:

"The Knoxville Power Company is a company organized to develop about 100,000 horse power on the Little Tennessee River at Alcoa. We are now finished with the preliminary investigation and are just entering into the construction work, consequently there are opportunities here for young men interested in engineering, and I would be glad to see more of our Wisconsin alumni than we have at present. There will be from time to time plenty of positions open for draftsmen and instrument men as well as inspectors, which could be filled by inexperienced graduates. The salaries are commensurate with those paid by other similar corporations, but salary is incidental to the experience those men will gain by their connection with such an exceptional development."

IN MEMORIAM

KARL WILLIAM KLOTSCH

In retrospection of the many successful engineering students of this university, there are few who stand out as clearly in our view as Karl Klotsch of the class of 1914. Having acquired no little eminence in the high school of his native town, Appleton, from his excellence as a student and as an athlete, he entered the university in 1910. Here too, by virtue of his unquestionable academic powers, he became quite prominent, making Tau Beta Pi in his junior year and later the honorary chemical fraternity, Phi Lamba Upsilon. Not only this but he became better known through his athletic prowess, making the varsity track team his sophomore year, and earning his "W" his junior and senior years in the high jump.

This promising young engineer became ill only a few weeks after his graduation. His death, which occurred after almost a year of lingering sickness was one of twofold sadness, since with his death was lost a man—a man of incomparable diligence, skill, and efficiency, a man whose memory will be of intrinsic inspiration to his friends.

R. B. W.

BOOK REVIEWS

PRACTICAL TRACK WORK—By KENNETH VAN AUKEN

Railway Educational Press, 14 East Jackson Boulevard, Chicago, Ill.

Reviewed by Prof. L. F. Van Hagan

The author of this book is a Wisconsin man, class of '09. He combines experience as a writer, gained on the staff of a railway magazine, with experience as a practical trackman, gained as extra-gang foreman with the Chicago & North Western Railway. As a result of this combination of experience he has produced a readable and instructive little book, covering the problems that confront a track foreman.

The author has chosen a field that was practically unoccupied. It is true that several excellent books have been written upon the subject of track and track work; but they have been written from the text-book viewpoint. Mr. Van Auken has written a book for the practical trackman. He avoids theoretical discussions and formulas; but explains the why and the wherefore of track practice in terms that are clear, concise and complete. The ground that he has attempted to cover,—and he has covered it with marked success,—is the organization of track forces and the methods of doing track work. His opening chapter on Labor and Organization will be found by the student to be well worth reading. The method of obtaining laborers, the sharp practice of labor agencies, the wiles of the interpreter, and the economics of good food are among the matters that are discussed briefly and pointedly.

The book includes an appendix, a glossary and a set of tables. The appendix and the tables present little of novelty. They are mere useful adjuncts. The glossary however is refreshing. As the old lady remarked after reading the dictionary, "It is full of interesting little things; the only trouble is, the stories are too short." The author is modest in calling it a glossary of track terms; it might have been labeled a dictionary of railway slang, for, in addition to the more or less dignified track terms recognized by the American Railway Engineer Association, we find

the homely phrases in which the mournful hobo, who has just been bumped by the canary, pours his grief into the ear of the unsympathetic roughneck bending the rails so that eagle-eye the hog-head can crowd the old battleship into the siding and clear the main stem for the special with the old man and the rest of the brass collars.

* * *

NOTES ON CONTRACTS, SPECIFICATIONS AND ENGINEERING RELATIONS—By DANIEL W. MEAD

Professor of Hydraulic and Sanitary Engineering, University of Wisconsin

Reviewed by Dean F. E. Turneaure

Professor Daniel W. Mead has just published a preliminary edition, bearing the above title, of a more complete work on this subject which he has in preparation. The present preliminary edition has been issued to meet the immediate needs of his students.

As the title indicates, the work is more than a book on contracts and specifications. Besides covering the law of contracts and the preparation of engineering specifications, this new work of Professor Mead's touches a number of fundamental questions of vital importance to the engineer which are included under the title "Engineering Relations." In the first chapter are discussed the fundamental principles underlying the correct relations between the engineer, the contractor and the owner. In the second and third chapters the legal relations of the engineer and the law underlying the subject of contracts are treated, and form the basis of more detailed discussion in the subsequent chapters. In chapter four the engineer's personal relations, commonly included under the subject of engineering ethics, are discussed and at the end of the chapter are presented to the student a large number of practical questions touching the proper conduct of an engineer in connection with professional and financial matters. Some of these questions present ethical problems which are not, at first sight, easy to solve. They furnish good material for thought on the part of the young engineer. Chapter five deals with the use of English, a factor of especial importance in the preparation of contracts and specifications.

Following these general chapters the remainder of the book takes up first a brief discussion of the preparation of designs and estimates and the day labor and contract systems of construction, and then proceeds with a detailed discussion of the preparation and letting of contracts and the writing of specifications. Instead of quoting a large number of sample specifications, as is commonly done in works of this kind, Professor Mead begins with a study of specifications for simple items of material and supplies concerning which the student may secure full information. He then follows this with specifications for fundamental processes and, finally, with the analysis of specifications for entire structures and plants. A valuable feature is the collection of drawings at the end of the volume illustrating simple engineering structures and intended to furnish the basis for the preparation by the student of specifications covering the simpler types of structures and structural elements.

The work is unique of its kind and is one which should be more valuable in the education of the engineer along fundamental lines than the usual book on this subject.

* * *

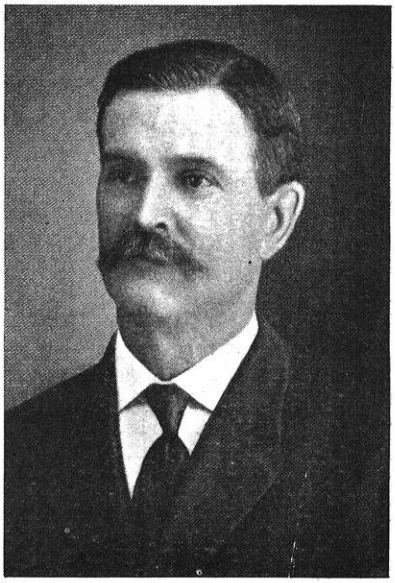
In its issue of February 3, 1916, the American Machinist published an article by J. B. Kommers, Assistant Professor of Mechanics, on a chart to determine maximum repeated unit stress.

A. Elmendorf, Instructor in Mechanics, has recently designed a machine for differentiating. It is described by him in an article in the Scientific American for February 12, 1916, under the heading, "A Differentiator; An instrument for laying out curves in engineering problems."

An article on bending moments in continuous reinforced concrete beams, written by R. J. Roark, Instructor in Mechanics, appeared in the Engineering News for January 24, 1916.

Successful Wisconsin Engineers.

C. W. HART



C. H. PARR

The list of Wisconsin's successful engineering alumni reaches out into many lines of activity. Perhaps the most unique, however, is the position occupied by C. W. Hart, president and general manager, and C. H. Parr, secretary, of the Hart-Parr Company of Charles City, Iowa, not alone because they are manufacturers of an oil tractor, but because they were the pioneers in the successful development of that capable machine.

In 1896 Messrs. Hart and Parr were graduated from the course in mechanical engineering. Throughout their university work they both specialized in gas engineering. Since graduation they have been continuously associated in business, and during this time have built one of the largest and best known industrial plants of the Middle West.

The Hart-Parr Company was started in 1897 in the city of Madison. The four years following developed a very satisfactory business in small gas engines of original design. In 1901 the business was growing so rapidly that expansion was necessary. Due to difficulty in securing real estate in Madison at a

reasonable rate, and because of their trouble in interesting capital, the company moved to Charles City, Iowa, the home town of Mr. Hart. The reorganization was at that time capitalized at $100,000.

In 1902 their first successful tractor was built. During the following year the company built eighteen of them, all but one of which are still in active service. About this time the Hart-Parr Company introduced the oil cooling system which has done much toward making the success of the oil tractor in colder climates. The demand for the tractor rapidly increased, and the company turned exclusively to its development and production. The resulting growth of the concern was the cause of its re-capitalization in 1907 at $200,000, and again in 1911 to $2,500,000.

In the last few years there has come a cry for small tractors. The Hart-Parr Company, in consequence, have developed their Little Devil, a remarkably powerful small tractor. With the increased manufacture of these machines together with the larger tractors, the company's plant has grown to a floor space of over twenty-two acres. The capacity of the present plant provides for the completion of a tractor every tweny minutes.

The Hart-Parr Company is a splendid example of the commercial possibilities of a technical education, enriched and matured by practical experience. The inspiration and confidence gained in college, combined with energy and courage, have enabled these men to establish a business which is at once a credit to themselves and to their Alma Mater and a boon to the agricultural and industrial life of the Middle West.