The Wisconsin engineer. Vol. 28, No. 7 April 1924

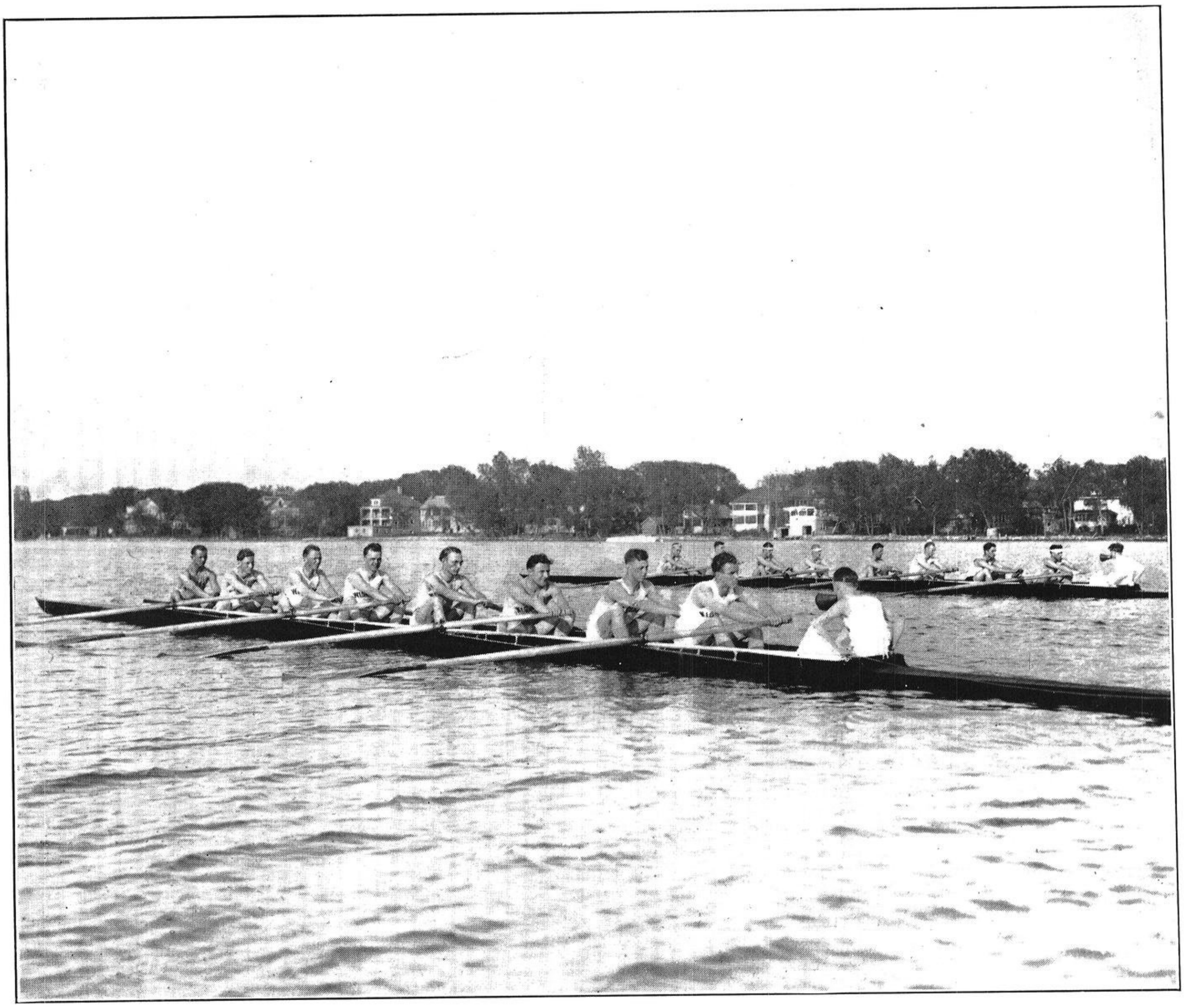
Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

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

The WISCONSIN ENGINEER

Published by the Engineering Students of
THE UNIVERSITY OF WISCONSIN

VOL. XXVIII MADISON, WISCONSIN, APRIL, 1924 NO. 7
Member Engineering College Magazines, Associated



The

WISCONSIN ENGINEER

Founded 1896

Published monthly from October to May, inclusive by
THE WISCONSIN ENGINEERING JOURNAL ASSOCIATION
306a Engineering Building, Madison, Wisconsin
Telephone University 177

25c
A COPY

$1.50
A YEAR

CONTENTS

VOL. 28 APRIL, 1924 NO. 7

The Wisconsin Engineer

UNIVERSITY OF WISCONSIN

VOL. XXVIII No. 7 — MADISON, WIS. — APRIL, 1924

THE RELATION OF THE ENGINEERING SCHOOL TO INDUSTRY

An Address Before the Milwaukee Engineering Society

By F. E. Turneaure

Dean of the College of Engineering

A University is an institution for the extension and diffusion of knowledge. Research and instruction are its two-fold functions. A purely teaching institution content with passing on the accumulated knowledge of the past, without active interest in extending the bounds of that knowledge and in verifying and perfecting it, is no more a university than is one devoted entirely to research, but which gives no attention to the production of educated men and women, in order that they may make more valuable members of society in every-day life or utilize their abilities in carrying on the work of research. It is especially the duty of a state institution to interest itself in such branches of instruction and research as shall be for the best interest of the people of the state, and which it is best adapted to undertake.

Agricultural research has long been a very prominent feature in the state institutions, and the propriety and importance of such work has been recognized by state and federal government in liberal appropriations for agricultural experiment stations; and there is hardly a farmer in the country who has not been aided directly or indirectly by the results of this very practical work. It is unnecessary to mention illustrations, as the subject is familiar to everyone.

Dean F. E. Turneaure.
(Portrait by T. F. Ziegler).

Engineering research has not, in the past, attracted as much attention as agricultural research, and has only recently been given much attention by those engaged in the manufacturing industries. There are good reasons why this is the case. Manufacturing methods and processes are, to a large extent, private property, and large units have organized their individual research departments, some of which are exceedingly well-equipped and far beyond anything which a state institution can hope to have. And for this very reason the public has not considered it so essential to support this type of research as in the case of the agricultural industry, where the units are small and unable to do individually the things needed. It is also true that the value and importance of engineering research has not been rated as highly as it has deserved to be, and, like the farmer, there are individual manufacturers who are a little slow to realize that scientific study and investigation may be of value to their work.

This condition is, however, rapidly changing, and there has been, as you all know, a very great increase, in the past ten years, in the amount of practical research related to industry. A very considerable per cent of the graduates in engineering, chemistry, and physics, now enter the research departments of such concerns as the American Telephone and Telegraph Company, General Electric Company, Westinghouse, Standard Oil Company, the Du Pont Company, and many others. In fact, research as a career is now quite an attractive field for young men of the right sort of ability, and considerable thought is being given to the preparation of such students. And not only are the large manufacturers giving increased attention to this field, but national engineering societies and other associations are giving it much thought.

A great impetus was given to this subject by the war. The national research council is still very active, and aids in giving financial support to many projects. The American Society of Civil Engineers has its Research Committee and numerous special committees engaged in active work. The Bureau of Standards at Washington and the Forest Products Laboratory of Madison are well-known examples of highly technical research organizations. Engineering research is organized and actively conducted in more than half of the State Land Grant Colleges, and the amount of money directly appropriated from state funds for that work last year amounted to about $280,000, and that donated from other sources to $180,000 more. Many of these schools have organized Engineering Experiment Stations.

Such, in brief, is the general situation. What is the condition at the University of Wisconsin? I think it may be said that while not the foremost in work along this line, this state university has done moderately well in its contribution to practical engineering research, and considering the amount of funds available, has made a fair showing. Perhaps a few instances of this work will help to give an idea of the sort and variety of problems the engineering school is best able to study.

In the field of interest especially to the Civil Engineer the University of Wisconsin was an early pioneer in the study of principles relating to the design and strength of reinforced concrete, and its work, with that of the University of Illinois, made up a large part of the information upon which the correct design of this form of construction came to be understood. Its representative was a member of the first Joint Committee to formulate rules and specifications. Many of the engineers and contractors in Milwaukee learned the fundamentals of the subject in these laboratories. Its several investigations on the principles and efficiency of the air lift pump have been the most important of their kind. It has co-operated with the Wisconsin Highway Commission in an economic study of local sands and gravel deposits of the state for their use in road construction leading to the development of many local deposits with considerable gain in economy, and the same laboratory has co-operated with national engineering societies in such questions as the best proportions for concrete, effect of freezing on concrete and on clay tile. It has conducted a great many experiments on bridges under moving trains, and the results of this study have formed the basis of the rules of practice of many railroads. In the Mechanical Engineering laboratory, its investigations on the insulating properties of commercial pipe coverings have been the most thorough up to date, and the results are used in the various handbooks covering the subject.

In the Electrical Engineering laboratories, much work is being done through its Standards Laboratory, maintained in co-operation with the State Railroad Commission, for the promotion of better service by the electrical utilities of the State. This has included such studies as high tension insulators, transformers for the lighting systems of Milwaukee, high voltage circuit breakers and fuses, and a great amount of work in testing and improvement of standards used by the utilities. In this department, also, a very considerable amount of hard study has been given to problems of radio communication, some of which are highly mathematical in their nature, and results published which are hardly readable by the ordinary engineer, but none the less of practical value.

An interesting example of the importance of scientific studies not at first appreciated came to our attention recently. One of our graduate students of about fifteen years ago was aided for two years or more by University funds in his studies of the properties of CO_2 at very low temperatures. It was a difficult subject, and satisfactory results were not then obtained. This particular person was very persistent in his ideas, and came back two years ago to complete his work. He is now in the employ of the Bureau of Mines, which needed just such a man in the work they are now doing in the recovery of helium from natural gas for use by the United States Government. In Chemical Engineering, a lot of work has been done in the properties of alloys, and we all know how important this field of work is in modern manufacture. This Department, in co-operation with the Wisconsin Gas Association, has reported on various process improvements, notably on the mixing of gas and air for high temperature furnaces, liquid purification methods for sulphur compounds, methods of removal of napthalene, and the relation of heating to gas consumption in household appliances. Co-operative work with particular industrial concerns includes work on gas calorimeters, corrosion tests, and lead plating processes. The metallurgical laboratory is now engaged in a scientific study of blast furnace slags, on which an expert metallurgist is employed. This is a very complex problem, and while the general behavior of slags is well known, a thorough analysis has never been made, and the ores make this study of much practical importance. The electrolytic treatment of zinc ores is another promising field of study.

A great many more examples could be given, but this enumeration is sufficient to show the general scope and nature of the problems which are being studied in the engineering laboratories. They are not merely interesting studies by college professors, but real practical investigations conducted by persons in close touch with the active world of engineering and manufacture. Satisfactory results are not, of course, always secured, but, measured by the relation of output to input, the expenditure of time and money has, I think, been reasonably efficient. In the past twenty years, the College has published about sixty special bulletins, most of which relate to research work. Many are out of print, and some have been reprinted to supply the demand.

Engineering research, like agricultural research, attempts to solve definite practical problems. While fully recognizing the great value and the necessity of

(Continued on Page 153)

RECENT DEVELOPMENTS IN STREET LIGHTING

By James Theron Rood

Professor of Electrical Engineering

It is a far cry from the electric street lighting of today to the other meagre arc lighting of the streets of our towns and cities during the century just past. Arc lighting was first shown at the Centennial Exposition in Philadelphia in 1876. Men not old in years can remember the old type of British arc lamp, the earliest successful arc light used for street illumination. The carbon electrodes, burned in the open air, lasted from four to six hours. If the light was to burn beyond midnight an attendant had to make the rounds of the lamps in the middle of the night to replace the carbons.

The Arc in Street Lighting

In the morning the small boys would hunt for the short lengths of carbons, not more than three or four inches long, that the trimmer had thrown down into the street. The upper electrode burned away twice as fast as the lower so the trimmer used for the lower electrode what remained of the upper carbon; a new electrode a foot or more long was placed in the upper holder. It was hailed as a tremendous advancement when an improved lamp was brought out having two sets of electrodes, side by side, and so arranged that when the first electrode burned out around midnight, the second pair was automatically cut in so as to keep the lamp burning for the rest of the night. The lamps were then trimmed only once a day, usually in the day time.

The earliest forms of generators supplying these lamps had no means for automatic voltage regulation in case any of the lamps on the line should go out. So in the earliest arc lighting stations it was the custom to hang long rows of similar arc lights up in the roof of the generator room; then whenever the current in one of the circuits rose above its normal value, due to the failure of a lamp on the street circuit to burn, the station attendant would cut in one or more of the lamps up on the roof, causing the current to assume its normal value. The result can easily be imagined. I can clearly remember how, as a very small boy, I was taken into one of these stations at night to see these lights burning. The whole station was flooded with a blaze of light such as I have never since seen. The lamps were striking and feeding, chattering and sputtering, while the illumination was so bright as to be almost blinding.

These street arc lamps were burned in series, just as they are today. This is the most economic method, both as regards electrical efficiency of the lamps and as regards the loss of power in the outside wiring circuits. These lamps were rated in candle-power, usually 1000 or 1200. Their efficiences were practically as high as the best arc lamps today. In fact, it may be said, that there has been little major improvement in arc lamps since their introduction. By the use of a small enclosing globe around the arc, the burning life of the electrode was greatly lengthened. By the use of materials other than carbon for the electrodes, we have improved the quality of the light, made it less bluish and harsh, made the arc more of a flame and less of a brilliant point of light, thus doing away with the grotesque wandering shadows of the early lamps. But if one of these old type lamps were to be burned today on one of our arc light circuits, it is very doubtful if the public would notice the difference between the old and the new lamps.

It was in those days, and it is today, seemingly impossible to make a successful arc lamp of low candle-power. This has made it necessary to space such lamps relatively far apart and to hang them high above the ground. If this is not done the resulting illumination in the space between the two lamps will be very uneven,—excessively bright under the lights, uncomfortably dark between them. This violates the fundamental demand of good lighting, that of small lighting units spaced close together, the ultimate condition being a continuous band of light. So while great improvements have been made in arc lamps, (longer electrode life, better quality and distribution of light and fewer interruptions in burning) the conditions of large unit candle-power output, wide spacing, and high hanging are just as unsatisfactory as they were in the early days of arc lighting, and it is a question whether or not the arc lamp will survive. The arc lamp serves fairly well for widely spaced illumination on the outskirts of a town, but even here it is a question whether the use of the newer types of incandescent lamp fixtures is not better engineering, especially from the standpoint of satisfactory illumination. More and more towns and cities are increasing the use of incandescent street lamps and reducing or doing completely away with the use of the arc lamp. Only recently Milwaukee has abandoned electric arc lights, gas and gasoline lamps, using 10,000 series incandescent lamps to replace them.

The Incandescent Lamp in Street Lighting

Attempts were made early to use the incandescent lamp for street illumination with both multiple and series operation, but the incandescent lamps of those days were in no way comparable with the lamps we use today. Their filaments were of carbon, their efficiency low,—about 3 to 5 watts per candle-power as compared with one-half to one, say, for arc lights. They had, however, the great advantage of being obtainable in units of low candle-power. This permitted their being hung closely spaced, as well as being placed in alleys and side streets or in dark corners. They could be hung low and required shorter and lighter supporting poles or posts, thus making it possible to place them so that tree shadows, always a troublesome matter on side streets and parkways, could be reduced to a minimum. These advantages were such as to encourage the attempt to use incandescent lamps for street lighting, especially in small towns and on the outskirts of larger places, but no great advance in the use of incandescent lamps for general street lighting came about until after the advent of the tungsten filament lamp. Its whiter light, higher efficiency, and larger unit candle-power output made it at once supersede the carbon filament lamp. The gas-filled, tungsten-filament lamp with its still higher efficiency and large candle-power output (up to 2500 c. p. in standard size,) bids fair to practically drive out the arc lamp for general street lighting purposes. A greater number of more closely spaced, better hung lamps can be used, and the candle-power size of the lamp can be selected for a given location. This means better illumination in every way.

Probable Future Developments

Nevertheless, illuminating engineers recognize the fact that neither the arc light nor the incandescent lamp, whether of the vacuum or the gas-filled type, gives the kind of illumination that is really desired. All have too high a specific luminous radiation; that is, the radiation of light flux per unit area of arc or filament is altogether too great. With the arc lamp, practically all of the light energy comes from a very small part of the surface of the electrode, only a relatively small proportion of the light flux emanating from the arc flame; the temperature of this spot is therefore very high indeed. The efficiency of the arc is high as a result of this high temperature. With the old style carbon-filament incandescent lamp, the brilliancy of the filament was relatively low. The color was of the red, yellow order, and one could look directly at the glowing filament without serious strain or discomfort. Its efficiency was low because the filament had to be operated at a low temperature. About ten per cent of the electrical energy received by it went into light flux, the remaining ninety per cent into undesired heat. The higher efficiency of the vacuum type, tungsten incandescent lamp is due to the higher temperature at which its filament can safely be made to glow. More energy goes into light flux, less into heat, but the filament is now so bright that it is very uncomfortable to look at. The introduction of gas within the bulb permits still higher filament operating temperature with greater efficiency, but the specific luminous radiation of the filament is also higher. We are going in the wrong direction. What is wanted is a lamp having a soft, glowing light of low specific luminous radiation, operating at low temperatures, but with high efficiency, restful to the eyes, and approaching daylight in its characteristics. Such a lamp would radiate only in the visible part of the spectrum. A gas alone can do this; no solid or metallic element can. The lamp would be a glow light with its entire globe or tube softly luminous.

At present the lamp that comes nearest to satisfying these requirements is the mercury or Cooper-Hewitt lamp. Strictly, it is an arc and not a glow type lamp. In its present form it is not a satisfactory light. It radiates only the green band in the spectrum. Its color can not be changed by surrounding it with colored glass; the result is no light at all. Attempts have been made to put the mercury in a quartz-glass tube and increase the electric energy passing through the mercury vapor to such a point that the resulting light is white. The resulting efficiency is high and the lamp is very compact. It has been tried out experimentally for street lighting, but, so far, has not proven satisfactory. Experimentation is going on with strictly glow lamps, tubes containing neon and other gases. Such lamps should give a soft light of low specific luminous radiation and the efficiency should be high. Up to the present time inherent difficulties have kept them from being a practical success. It would seem, therefore, that for a number of years, at least, the arc light and the gas-filled incandescent lamp will have to be the two general street lamps, with the incandescent lamp coming more and more into use.

Sectionalizing the Street Lighting Problem

As concerns lighting, the streets and highways of our centers of population may be divided into four types of districts or sections; (1) the main business section, (2) the main residential and secondary business sections, (3) the outlying residential sections, (4) the highways or the outskirts. Each of these should have its own method of lighting, its own type of lamps, fixtures, and hanging, if the best illumination results are to be had. In each the method of illumination has changed greatly within the past ten years.

(1) Main Business Sections

In the immediate past, the main business sections of our town and cities have been electrically lighted by both arc and incandescent lamps, the latter in arched or festooned strings of lights or the multiple cluster "white way" lighting. These all served their purpose in their day, but should now be considered as of the past. The short column or post surmounted by one, two, or three lantern-type fixtures, each containing a luminous arc lamp or a gas-filled incandescent lamp has almost entirely superseded them and should be used wherever possible,—certainly in the main business part of our cities if the best lighting effect is desired. The lead and steel-covered, so-called "parkway" cable, laid directly in the ground, has made this possible. There is no longer any need of carrying unsightly and dangerous lighting circuits on overhead poles through such districts. A possible hazard in case of a large fire is thereby removed.

For cities of 20,000 to 100,000 population each post should carry a total of about 1000 to 2500 candle-power. The posts are commonly from 14 to 18 feet from ground to lamp and are spaced from 75 to 125 feet apart, usually in parallel rows on the two sides of the street. The lamp candle-power per foot length of street between the posts may range from 8 to 60. Large, extra-high efficiency incandescent lamps of about 2500 candle-power are now available for this type of lighting, so that single-lantern fixtures may be used. For centers of population of 5,000 to 20,000, the lamp candle-power per post ranges from 600 to 1500; the posts are from 14 to 18 feet high, and are parallel spaced 75 to 125 feet apart with lamp candle-powers of 5 to 35 per foot length of street.

The use of a post with three to five opalescent globes, inverted or pendant at the top, is rapidly going out. The multiple panel lantern fixture is supplanting it. The earlier designs of these lamps had curved panels, but the newer ones are flat panelled, larger at the top than at the bottom. The milky opal glass is also being superseded, either by roughened clear glass, or glass with raised pattern, or else with the same roughened or raised glass with a slight opal effect. With clear glass, the light lost is 10 per cent or less; with very slight opal, 10 to 15 per cent; light density, 15 to 25; medium density, 25 to 40; dense, 40 to 50; very dense, 50 or more. The top of these lantern fixtures when placed in the business section are often made of glass, and no inside reflector or refractor used. This is done in order that the fronts of the buildings may receive a considerable amount of illumination. If this is not done a business section may have a gloomy, half-dead appearance. Single posts may commonly be erected for about $100 to $150 each, depending on the design and the amount of ornamentation. There is a decided tendency today to have the posts of gray or neutral tone. This makes them less conspicuous and they show dust less than black. The annual cost of such lighting may run from $0.80 to $4.00 per street foot. The tendency everywhere is towards better lighting, closer spacing of poles, greater lamp candle-power per post with resulting higher lamp candle-power per foot length of street. This is certainly as it should be and the better lighting will pay in more ways than one. Police service, heavy traffic, and attractive and progressive appearance demand it; there should be high light intensity on the sidewalks and street, with the fronts of the buildings well illuminated.

A novel street lighting method is now being experimented with in connection with busy street crossings where automobile and foot traffic is high. It consists in placing incandescent lamps directly in the curb or just above it, thus flooding the surface of the road bed with light. This should place the light where it is most needed, yet there would be no glare in the eyes of either pedestrians or drivers. If this method of lighting proves satisfactory it ought to be better than any of the methods now used, such as that of flooding the crossing with light from flood-lights located on the tops of adjacent buildings.

(2) Residence and Secondary Business Sections

Here the post type of lighting is coming to be the accepted method. The requirements are police service, ability to recognize pedestrians, a moderate intensity of light on street surface, sidewalks, and entrances to buildings, with but little or no light or glare on the upper stories. The lamp candle-power per post commonly runs from 250 to 600, and the mounting height from 14 to 20 feet. The lamps are frequently placed all on one side of the street with a spacing of 125 to 250 feet. The parallel or staggered arrangement, though somewhat more expensive as to first cost, gives a more pleasing appearance to the street. It is now quite common practice to place a glass refractor inside the lantern and around the center of the lamp to throw the light downward, so as to keep it out of the eyes of the drivers as well as to prevent it striking against the upper stories of the residences. A cost of fifty to eighty cents per foot length of street per annum may be expected.

(3) Outlying Residential Sections

Here the lighting requirements are police service, ability to discern persons and vehicles, relatively low intensity of lighting on streets, sidewalks, and residence entrances, with a minimum of lighting against the upper stories. On account of the hight cost of using parkway cables in such sections, it is frequently impracticable to use post lighting. Since the wires will then have to be carried on regular pole construction, it is quite common practice to use long goosenecks or mast-arms, supported by the poles and projecting well outward towards the center of the street. Incandescent lamps of low capacity are hung downward from the end of the arms by means of inexpensive fixtures carrying a suitable reflector with or without a refracting glass cylinder surrounding the upper portion of the lamp to throw the light downward at an angle. This will keep the light from being partly lost in the trees, shining in the eyes of drivers or pedestrians, or causing glare against the upper parts of the houses. The lamps are usually placed along one side of the street only. The lamp-candle-power is commonly from 100 to 250, the suspension height from 16 to 20 feet and the spacing 200 to 400 feet. The lamp candle-power per foot length of street runs from ¼ to 1. The cost per foot length of street per year may be expected to run from ten to fifty cents.

(4) Outying Highways

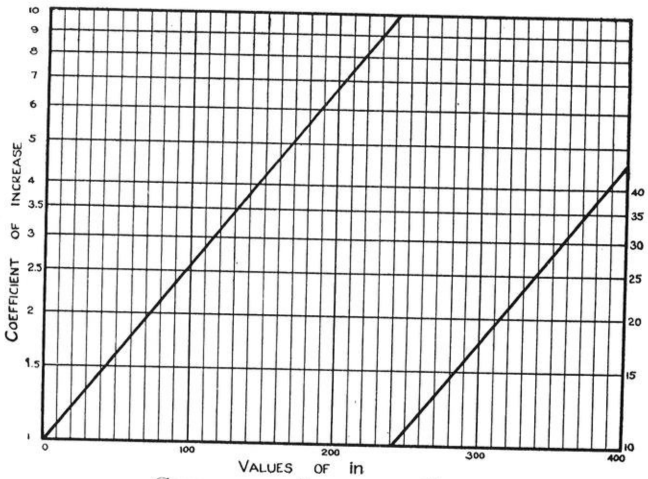
One of the most interesting developments of street lighting in recent years is the application of a new method for illuminating the main arterial highways leading into our towns and cities. It is now practically conceded that it is impossible to make an automobile headlight which will not glare in the eyes of approaching drivers and yet will give light enough for safe driving. At best the glare can merely be reduced to a still decidedly uncomfortable minimum. This simply means that if we are to have safe, comfortable driving on our main highways at night and on late winter afternoons there must be illumination of the highway itself. Such lighting would tend to prevent accidents, which are growing greatly in number. It would aid in the comfort of night driving and thus tend to increase business between our cities and their surrounding territory. This increase of night traffic would have the effect of either greatly increasing the utilization of our expensive highways or else it would spread the traffic more evenly,

(Continued on Page 152)

A COMPOUND INTEREST CHART

Earl Raimon Stivers
Instructor in Railway Engineering

The engineer who lacks a knowledge of the fundamentals of compound interest is likely to make costly blunders. "Build for the future" may sound well as a slogan, but reduced to dollars and cents it may be not only poor advice but utter folly. If, for instance, a gravel road at $10,000 a mile will serve a given community just as well for 16 years as a concrete road will at the cost of $30,000 a mile, the amount of money saved on interest alone at 6% will build the concrete road at the end of that period. Other items, of course, such as maintenance, can not be entirely overlooked but the interest will usually be the paramount item.



Compound Interest Chart

The accompanying chart shows how rapidly money increases thru the medium of compound interest. Here i indicates the rate of interest in per cent, n, the number of years it is to run, and c, the rate of increase. Values of i times n are plotted as abscissa and values of c as ordinates, while the diagonal line gives the relation between the two. The true law does not give the same straight line for all values of i, but it is sufficiently near to it to make this simple diagram possible. For values of i between 0 and 20 per cent, the values from the diagram modified by the percentages in the following table will give accurate results.

CORRECTION TABLE FOR VALUES OF n

Per cent Interest	True value of n Per cent of value on diagram
2	96
4	97
6	98
8	99
10	100
12	101
14	102
16	103
18	104

Some simple problems will illustrate the use of the chart.

1. How long can an improvement be deferred in order that the interest saved shall be sufficient to pay for the improvement if in the meantime it is not needed?

Solution: On the chart the horizontal line marked 2 intersects the diagonal line at 72 for the value of in. Then in = 72

If i = 4% n = 18 years
If i = 6% n = 12 years
If i = 10% n = 7.2 years

2. How many years will it take $1 placed at 6% compound interest to amount to $5?

Solution: On the chart the horizontal line marked 5 intersects the diagonal line at the value 169 for in. Then if in = 169

$$n = \frac{169}{i} = \frac{169}{6}$$

n = 28 + years

3. If placed at 5% compound interest what will $1 amount to in 20 years?

Solution: in = 5 x 20 = 100

On the chart the vertical line 100 intersects the diagonal line at about 2.6.

Answer: $2.60.

The foregoing shows, then, why it is poor engineering to build for the future when the latter is unjustified. At no time can the engineer afford to decide arbitrarily as to whether or not a given improvement is economically sound. Neglecting to investigate this phase of the problem as carefully as the technical details is to court ultimate failure and to leave structures in his wake as monuments to his colossal ignorance.

NEW YORK CENTRAL USES AUTO TRUCKS FOR LESS THAN CARLOAD LOTS

Annulling its way freight train, the Putnam Railroad, a branch of the New York Central & Hudson River Railroad, has just substituted an automobile truck service in Westchester County to handle less-than-carload shipments between various stations from Yonkers to Brewster. Hitherto, the Pennsylvania Railroad has been the only one actually to place trucks in operation.

Automobile trucks now take freight from the Hudson Division of the New York Central at Yonkers to Dunwoodie station on the Putnam and all stations north as far as Yorktown Heights. Another truck collects and delivers freight between Yorktown Heights and Brewster, stopping at all intermediate stations. Formerly a local freight train picked up and delivered all these smaller freight shipments. If the service proves as satisfactory as expected, additional trucks will replace local freight trains on other divisions of the New York Central, says Superintendent Vantassel.

—*The Iron Age.*

COMMERCIAL ALUMINUM ALLOYS

By George Koresh
Senior Chemical

Aluminum is one of the most abundant of the elements. It constitutes almost eight per cent of the earth's crust and is found mainly in feldspar, mica, granite, slate, and clay. The metal was discovered by Wohler in 1828 and was a curiosity until the time when the electric furnace came into use. In 1883 there were 83 pounds of it in the United States, whereas in 1912 the quantity was estimated to be sixty million pounds. The metal is now prepared by the reduction of bauxite at high temperatures. Although the tensile strength of the metal is low, the metal is light, has a high elongation, and has 60 per cent of the electrical conductivity of copper.

Because of its low strength, softness, and difficulty of machining and casting, the pure metal is not suited as a material of construction. With the advent of the motor car and airplane, however, many attempts were made to utilize the useful properties of the element and to improve those in which it was deficient. At first these attempts resulted in such an indiscriminate use of other metals to form aluminum alloys that aluminum was given a bad reputation. The exaggerated ideas of the scope of its usefulness militated against its employment for those purposes for which it was best suited. Many alloys have appeared with extravagant claims which have proved false in actual test.

Large amounts of time and money have been spent in investigating alloys of aluminum with every known metal. This work has been done by the United States Bureau of Standards, the National Physical Laboratory of England, and many private companies. During the war, research, development, and adaptation were carried out intensively. The metallography, metallurgy, chemistry, and physics of the alloys were studied together with the founding and melting problems, and the problems of alloying and heat-treating. Although much has been done on aluminum alloys, much remains to be accomplished because aluminum gives rise to complicated chemical systems which make scientific investigation a difficult matter.

Aluminum alloys may be grouped into three classes: (1) those containing 75 to 95 per cent aluminum, (2) those containing not more than 10 to 15 per cent aluminum, and (3) those containing 95 per cent or more of aluminum and the balance of rare metals. In order to make aluminum stronger and harder and to give it better wearing qualities, while yet retaining its valuable lightness and color, it is alloyed with varying amounts of suitable metals such as manganese, magnesium, zinc, copper, and nickel. There are few binary systems,—i. e., alloys of two metals, but ternary and quaternary systems containing metals which would be undesirable in a binary system become useful. The reason that a particular metal may give useful alloys only in a certain range of composition is that aluminum forms compounds and solid solutions which, when passing their solubility limits, change the properties of the alloys.

Within the first group mentioned above we find alloys such as duralumin, magnalium, and Number 12 alloy. Duralumin consists of 95 per cent aluminum, 4 per cent copper and 0.5 per cent each of manganese and magnesium. It is not suited for casting but is much used for wire and sheets. It weighs about one-third as much as cold rolled steel and has practically the same characteristics as a 0.30 per cent carbon steel. The greatest difficulties in the use of this metal are flaws and impurities in the ingot. The alloy is widely used for automobile and airplane parts. A modern dirigible contains ten to twelve tons of this metal.

Magnalium may contain from 2 to 25 per cent magnesium with small amounts of other metals. This alloy is lighter than aluminum and has good machining properties. The 15 to 25 per cent alloy is hard, ductile, and resistant to corrosion and is easily rolled. Castings made from it are dense and free from blow holes. The 10 to 15 per cent alloy can be forged, rolled, and drawn. An increase in the magnesium content of magnalium alloys increases the strength and also the brittleness. Magnalium alloys are more expensive than other aluminum alloys.

Number 12 alloy (lynite) contains about 92 per cent aluminum and 8 per cent copper and is being widely used for pistons because it has three times the heat conductivity of iron.

"Y" alloy has 4 per cent copper, 2 per cent nickel, and 1.5 per cent magnesium. The tensile strength of a rolled and heat-treated specimen is about that of mild steel. This alloy retains its strength at high temperatures better than any other aluminum alloy. Additions of iron, molybdenum, tungsten, chromium, and vanadium make castings extremely brittle and porous. "Y" alloy is one of the heavier of the aluminum alloys and is distinctly superior to most of them in ease of manufacture. It is remarkably resistant to corrosion and practically immune to season cracking.

Aluminum-silicon alloys have been of much interest during the last few years. They are very resistant to corrosion if the iron content is not excessive. The alloys possess good casting and machining properties. It is interesting to note that alloys of identical composition but prepared by different methods have different properties. Alpax contains 13 per cent silicon. It is light, strong, and has a low coefficient of expansion. It is used for pistons, connecting rods, and other automobile parts. It is very resistant to salt-water corrosion. Aladar, or silumin, is another aluminum-silicon alloy which is widely used in automobile parts. It can be used as a substitute for bronze, and its heat con-

(Concluded on Page 152)

EDITORIALS

FREE ELECTIVES. After the engineering student has completed the first two years of his college work, the opportunity is given him to devote a portion of his time to courses of his own choosing. Often he does not know what to do with his new-found fredom; he is like a canary escaped from its cage. Instead of considering non-technical courses outside of his own field, he frequently loads up with studies in the particular branch of engineering in which he expects to specialize upon graduation. The result is a further narrowing of an already narrow training, and he leaves the university with but little appreciation of anything in life beyond the restricted phases of his profession.

The College of Engineering does not attempt to turn out finished engineers—that cannot be done in four year's time. What it does hope to accomplish is to give its graduates the fundamental technical equipment necessary for their future work, and, at the same time, broaden their outlook, that they may be better fitted for the bigger jobs and not become "one string players" like trade-school men.

The faculty realizes the desirability and worth of a comprehensive education, and the inclusion in the various engineering courses of these free electives is an attempt to widen the student's perspective. Choose your electives with this in mind, and not entirely on the basis of what they may mean to the weight of the pay-envelope. Your intercourse with mankind, your philosophy of life, and your appreciation of the work of others needs attention, for it is upon such that much of happiness depends.

Have a purpose in life, and having it, throw into your work such strength of mind and muscle as God had given you. —Carlyle.

AN OPPORTUNITY TO MAKE A SHOWING. An instructor in engineering assigned some work outside of the text-book. It required a little investigative work and some original thinking. It was an opportunity for the students to make a showing before that instructor, whose good opinion might mean a job at the end of their college careers. Of the fifteen men in the class, one did a really creditable piece of work, — a piece of work that proved his ability to undertake such investigation. The work of the other men ranged from fair down to the obviously perfunctory performance. The chance to make a showing had come to these fourteen men and they had passed it up as not worth the effort. Probably there were various reasons for this: The assignment may have lacked interest for certain men; they may have cared nothing for the instructor's good opinion; they may have been overloaded with work; they may have considered a school assignment as relatively unimportant; they may have been just plain lazy. None of the reasons constitutes a valid excuse. In allowing themselves to submit inferior work, the men added strength to the habit of doing that kind of work, and in flouting the instructor's opinion they needlessly created a bad impression of themselves, — an impression that at some future date they may regret.

Just an opportunity to make good is all that any man should ask. The heartbreaking thing is to be denied that opportunity. And a man must be consistent about seizing opportunities; he cannot hope to improve just those that offer a direct and immediate return; he must cultivate the habit of doing well whatever he undertakes if he is to win a reputation for reliability and thoroughness.

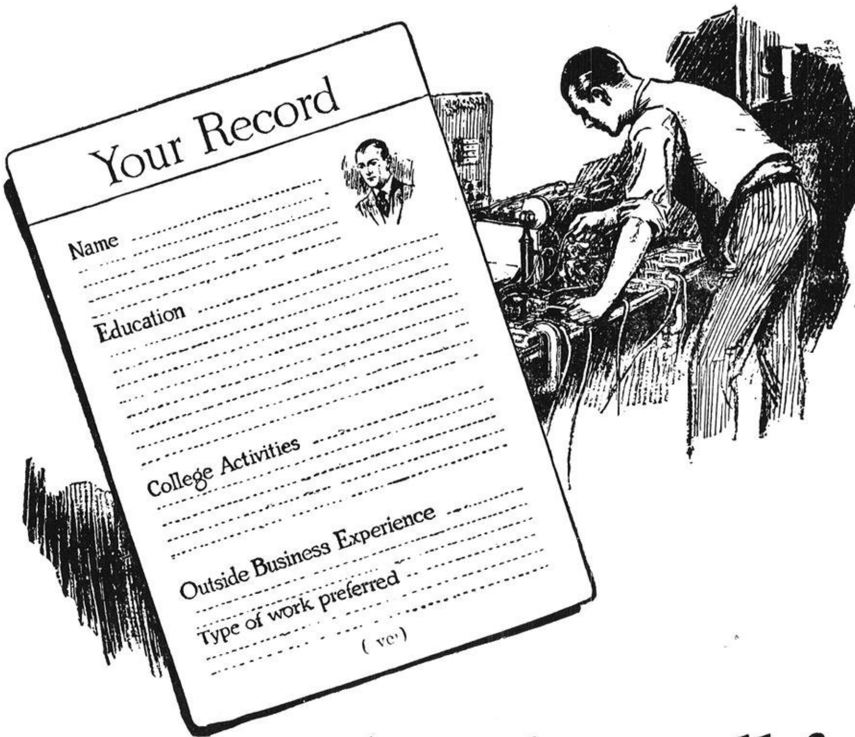
Discourage litigation. Persuade your neighbor to compromise whenever you can. As a peacemaker the lawyer has a superior opportunity of being a man. There will still be business enough. —Abraham Lincoln.

A SUBSTITUTE FOR EFFORT. What seems to us to be an able summation of the various aspects of that much discussed query, "Is a college education worth while?", appeared in a recent issue of the bulletin of H. L. Stevens and Company. In the following quotation, the italics are ours.

"The college trained man has not been an outstanding success with us when one considers the large number of college men who have passed through the organization in the past fifteen years. Perhaps this is our fault, but it seems to be more the fault of the man himself and the perspective he gets of life because of his college course. Somehow or other he gets the idea that it is in a way a substitute for hard work, and that because he possesses a diploma he is relieved to a certain extent of the hard mental and physical grind that a man must endure to obtain success in any line of work. *If he could get the viewpoint that a college training is to fit him to make his efforts count more efficiently rather than to relieve him of any effort, it would make his college training worth while.* There is no doubt but what a college training should be a good thing for a young man, and almost invariably the successful men who are not college men see to it that their own sons get a college training."

"A man to be an executive must be thoroughly informed of the work in which he is engaged. Other-

(Concluded on Page 150)


Your Record
Name
Education
College Activities
Outside Business Experience
Type of work preferred

ALUMNI NOTES

F. D. Blanch

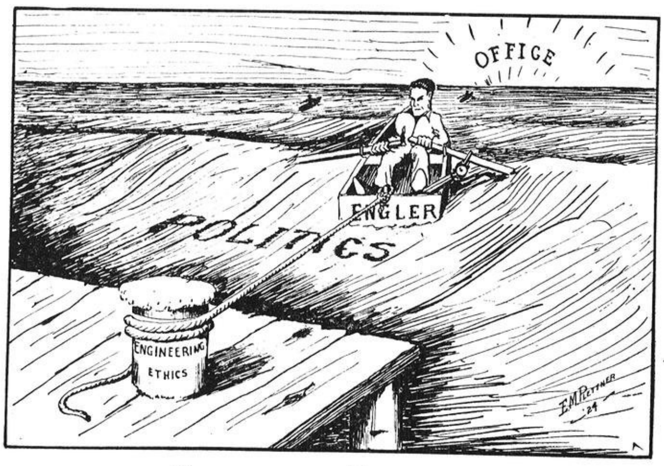
CIVILS

Ray E. Behrens, c '19, has been appointed assistant civil engineer for the recently created planning commission for Milwaukee County. The offices of the commission will be in the Manhattan Building at 133 Second Street, Milwaukee.

Walter P. Bloecher, c '14, is senior structural engineer with Stone & Webster. His residence address is 142 Langdon Street, Watertown, Mass.

Maj. J. Frank Case, c '90, consulting engineer, writes to the dean from Constantinople: "Your letter of November 22 followed me from Paris to Bucharest, thence to Rome, and finally caught me here toward the end of January. I cannot tell you how pleased Mrs. Case and I are to know that the fund (Archibald Case Loan Fund) is doing so much good, nor how grateful we are for the information regarding it. I am ready at any time to increase the fund.

"My work is sending me to odd parts of the world. Last year I made two trips to South America,—one to Venezuela to examine port works and an hydro-electric project, and one to Uruguay and Argentine on sanitary and hydro-electric works. From the latter countries I returned to New York on October 29 and sailed for Europe on November 3, a very short time to spend at home. After conferences in London and Paris I went to Bucharest on projects for tunnels on the government railways and sanitary works for the city, thence to Sofia to look into the proposed and greatly needed water supply and hydro-electric installation for that city. Then to Italy with a port project and finally Turkey. Tomorrow I leave for Greece where I shall be for some time."



Conflicting Elements

Hugo F. Engler, c '23, announces that he has turned politician and is making a race for the position of city engineer of Waukesha. His residence is 526 W. College Avenue, Waukesha, Wis. He is at present teaching engineering subjects at Carroll College.

Lewis Hamond, c '10, has taken active management of his father's business, The Hammond Printing Co., in Milwaukee.

P. E. Hanson, c '22, has changed his address to 2nd Floor Ledger Building, Birmingham, Alabama.

F. M. Johnson, c '06, may be reached at the Bureau of Public Roads, South Chicago Post Office Bldg., Chicago, Ill.

H. A. Marshall, c '15, is a member of the firm of Eidmann and Marshall, consulting Engineers, at Topeka, Kansas.

Clifford Older, c '00, has resigned as Illinois highway engineer to devote his time to the Consoer, Older and Quinlan engineering company of Chicago.

W. J. Seder, c '21, is with the McClintic-Marshall Co., Wilkinsburg, Penn. His address is 738 Ross Ave.

James Albert Shad, C. E. '16, is being transferred from the St. Paul office of the Corrugated Bar Company to the Main Office, Chicago, Ill.

F. V. Sherburne, c '10, gives his address as 444 Kenmore Place, Milwaukee, Wis. He says that this address is permanent as he has just finished building a new home there.

W. F. Tubesing, c '05, is the new president of the Milwaukee Builders' and Traders' Exchange.

CHEMICALS

Donald Grenfell, ch '14, is with the Mineral Point Zinc Co., at Dupue, Ill.

Louis Kreuz, ch '17, is in charge of one of the largest plants of the Detroit City Gas Company.

W. J. Tanner, ex-ch. '16, was married on February 24 to Miss Clara Mueller, at Milwaukee. Their address is 763 Murray Ave. Tanner is a salesman for the S. Obermayer Company.

Jacob Trantin, ch '15, is a metallurgical engineer with the Pettibone-Mulliken Co., 4055 Sheridan Road, Chicago.

ELECTRICALS

R. H. Herrick, e '22, gives his address as 521 Forest Ave., Oak Park, Ill.

Wilbur Magann, e '22, is in the maintenance department of the Illinois Bell Telephone Co., at Chicago.

R. C. Newbury, e '12, is now associated with the Community Traction Company of Toledo, Ohio.

Clarence Peterson, e '21, is engaged in construction work for the American Brass Co., at Kenosha, Wis.

The following is a list of the Electricals who finished their course in February:

D. E. Aultman, with the General Electric Co., Schenectady, New York.

L. F. Berg, with the Automatic Electric Co., Chicago, Ill.

E. C. Bopf, with the Automatic Electric Co., Chicago, Ill.

Roy Dowling, with the Western Electric Co., Milwaukee, Wisconsin.

Sandy Duket, with the Northern Indiana Gas and Electric Co.

I. C. Gartner, with the Consumers Power Co., Jackson, Michigan.

R. E. Hering, with the Wisconsin Telephone Co., Milwaukee, Wis.

L. E. Hume, with the Wisconsin Telephone Co., Milwaukee, Wis.

Royce Johnson, teaching mathematics at the Univ. of Wis.

M. J. McMurran, with the Utah Power and Light Co.

A. G. Manke, with the Automatic Electric Co., Chicago, Illinois.

(Continued on Page 150)

EXTENSION NOTES

The blueprinting department of the Extension Division recently installed a battery of five Pease Universal High Power Arc Lamps to replace the original equipment. The new lights have arcs of about three inches which produce a much stronger light than the lamps used previously. The high power lamps have practically air tight globes, the carbons burning in a near vacuum. The carbons burn more slowly as a result and there is not the necessity for frequent removal of carbon burned to short length as there was with the former equipment. However, if a change of carbons is necessary while the machine is in operation, either carbon may be removed without touching the hot lamp globes. Removing carbons while the lamps were hot was a difficult operation with the former equipment.

These high power arc lamps throw a much more intense light. Metal shields are necessary to enclose the glass over which the paper is drawn so that the light does not strike the paper and spoil it before the tracings or Van Dykes are placed in position on the paper for exposure. Notwithstanding the brilliancy of the lamps, it is claimed that they work less injury upon the eyes. Some operators using the original equipment found dark glasses necessary.

The speed with which the prints may be made has been increased greatly. The fastest standard paper has been used as a rule in the Extension Division. This paper lacks the permanency of slower paper, but the blueprinting equipment is used but three or four hours a day, and an output of less than 480 prints an hour seemed to be the least that could be tolerated if the printing output was to be kept up to the demand. When the new high power lamps were installed, no change was made in the speed of the paper used at first. An output of 1440 prints per hour was attained, necessitating two operators to feed the tracings or negatives sufficiently fast to keep up with the machine. A slower paper is used at present which results in a more satisfactory quality of prints. About 540 prints are made per hour with the slower paper.

It is impossible also to make Van Dyke negatives with the high power lights. Formerly, Van Dykes were made upon a separate machine which was of the vertical type instead of a continuous process machine.

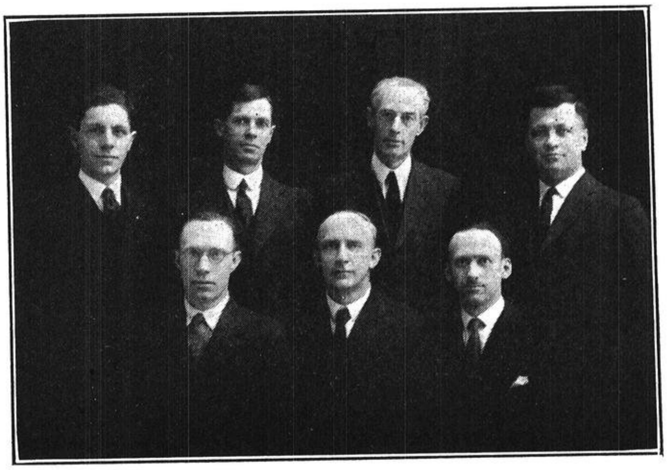
Copies of the radio broadcast "Getting the Most out of the Home Furnace" given by Professor W. E. Wines of the University Extension Division from the University of Wisconsin Station WHA are available, and may be obtained upon request to the Extension Division.

The Ninth Annual Meeting of the National University Extension Association will be held at Madison, May 8, 9, and 10. The Association, which was organized at Madison in 1915, now has thirty-eight institutions in its membership. Richard R. Price, director of the Extension Division, of the University of Minnesota is president for the ensuing year. Over 100 extension workers will be in attendance.

Exhibit materials are being sent from the various divisions, and an interesting exhibit of Extension activities of the entire country will be on display.

The program will consist of round table discussions on extension problems such as standardization of extension courses, the workers education movement, extension publicity, visual education.

Hon. John J. Tigert, Commissioner of Education, Department of the Interior, will attend the meeting and give an address at one of the evening sessions.



ENGINEERING STAFF, *Milwaukee Branch of University Extension Division.*

TOP ROW, *(left to right) H. W. Wesle, B. S., Instructor in Civil and Structural Engineering, Harry T. Avey, M. E., Assistant Professor of Mechanical Engineering, W. J. Fuller, B. A., Associate Professor of Civil and Structural Engineering, Arthur A. Sperling, B. A., Instructor in Mathematics.*

BOTTOM ROW, *(left to right) G. G. Town, M. S. PhD., Instructor in Chemistry, Harry P. Wood, B. S., E. E., Professor of Electrical Engineering, Charles H. Marx, B. S., Instructor in Civil and Structural Engineering.*

Among the names of students registered for the course in Fuels and Combustion are Spark and Slack.

ENGINEERING REVIEW

H. C. Wolfe

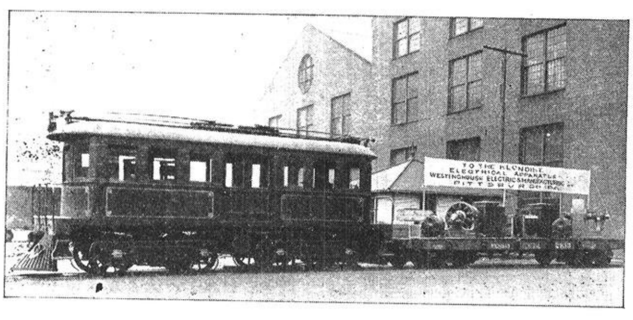
RAILROADS BUYING 30 PER CENT OF 1924 STEEL OUTPUT

Railroad buying is responsible for 30 per cent of present steel purchases, according to the *Iron Age*.

It reports that production of steel is running at a rate which, if continued, will bring the year's total up to 45,000,000 tons. A continuation of this rate, the report says, would bring the proportion purchased by the railroads approximately 10 per cent above that of last year. In the week ended February 16th, 12,000 tons of the 34,000 tons of structural steel work were due to railroad orders.

ELECTRIC LOCOMOTIVE DEVELOPMENT

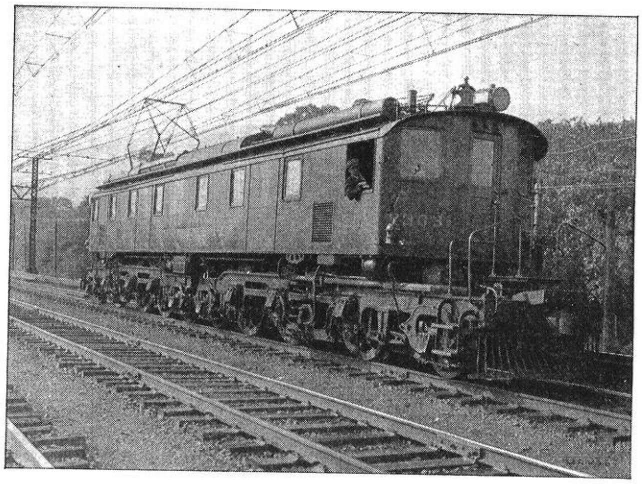
The first Baldwin-Westinghouse locomotive was completed in 1895, and was equipped with various experimental devices. The mechanical parts of the locomotive weighed 63,000 lbs., and the complete machine with an equipment of four 150 hp. motors weighed 92,000 lbs. Direct-current, single-phase a-c. and three-phase a-c. motors were tested out on this locomotive. It is interesting to note that this original locomotive, with a direct current equipment, is still doing good service on the Lackawanna & Wyoming Valley Railway.



The First Baldwin-Westinghouse Locomotive, Built in 1895.

Another interesting type of locomotive which was brought out by the Westinghouse Company in 1896 was one adopted for mine haulage. It was equipped with two 100 hp. motors which were connected to two of three driving axles by means of double reduction gears. The middle set of drivers was of the "blind" type, and connecting rods were provided connecting all wheels so that the total weight of the machine could be used for adhesion.

The first motor was soon followed by a second motor design known as the No.3, which was of the four-pole type, and which eliminated one pair of gears, making it the first successful single reduction railway motor in existence. After a period of more than thirty years, some of these motors are still in operation.



Electric Locomotive Built Recently for the New York, New Haven, and Hartford Railroad.

This motor was followed in 1894 by the design of the No. 12-A motor, which was probably the first totally enclosed motor used in railway service. With the completion of the design of this motor at this early date the fundamental foundations were laid which are used in the large majority of the present-day railway motor designs, that is, a motor supported on one side by axle bearings and on the other side by springs; a single reduction gear drive; totally enclosed working parts; four-pole construction; and an armature built up from laminated toothed punchings.

The first single-phase railway motors were built by the Westinghouse Company in 1894 and were placed in operation on an experimental line nearby the home of Mr. Westinghouse at Pittsburgh, Penn. These motors were rated at about 15 hp. and were operated at a low frequency. They represent the first steps taken respecting a method of development which eventually led to the present extensive equipments on the New York, New Haven & Hartford Railroad, the Pennsylvania Railroad, the Norfolk and Western Railway.

(Concluded on Page 150)

ATHLETICS

G. H. Abendroth

Conference meets have been held in wrestling, swimming, gym, and indoor track. The basketball championship has been decided, and, as a result, virtually all indoor athletics have ceased to function actively. However, other activities are ready to fill the breach,—baseball, outdoor track, and crew being the major ones, with tennis and golf as added attractions. With coach Vail's announcement that he is going to recommend the trip to Poughkeepsie this spring comes the realization of a long-held hope on the part of lovers of rowing. The Wisconsin crew at Poughkeepsie has always placed among the leaders and did more in by-gone days to spread the name of Wisconsin than any other athletic team. We are all with you, crew.

Although only one conference championship was annexed by Wisconsin athletic teams, the season came out as well as might be expected. The swimming, gym, and track teams, although not successful in their quest for championship honors, succeeded in bringing a few of their stars into the scoring column. Bob (Bearcat) Holmes upheld Wisconsin's fame in the wrestling world by winning the championship in his event in the conference meet.

BASKETBALL

With the conference standings giving us credit for four wins and three losses, our team started on the last lap of the championship race. We had a fighting chance for first, but we had a more probable chance of ending up among the trailers. Captain Gibson and his men have forcefully demonstrated the fact that a Wisconsin team may be down, but that it is never out.

Northwestern was encountered on our home floor, and after a slow and uninteresting game, the Purple went back to Evanston with their zero percentage undisturbed. It seemed as if the Badgers were saving strength for the big battles that were appearing on the horizon. Ohio, with the same team which had given us a sound whipping only a week previous, came here prepared to repeat the trick and thus put a complete damper on our slim championship hopes. However, the victory over Northwestern had only whetted the spirit of the Wisconsin team, and, with Kady Farwell sinking basket after basket and the rest of the team playing like a house afire, Ohio's team looked as if it was glued to the floor. The Buckeyes soon woke up to the fact that they had not been playing basketball,—instead they had been watching the Badgers run circles around them.

This 30-20 victory put us in second place. Chicago was only a game in the lead. Our prospects for a championship had taken a much brighter hue. We were all prepared to tear Iowa, our next oponent, to pieces. Iowa, however, had ideas of her own, and before the first half was over, our team knew that it was in a real basketball game. The "Hawks" did not give us a chance until near the end of the second half. Then the Wisconsin team, realizing that their grasp on the championship title was weakening, staged a last minute ralley. After counting up the many points that were made in that sensational last minute rush for the basket, we found ourselves two points short of Iowa's total.

A chance to tie Chicago for first place still existed if we won our two remaining games. Iowa came to Madison for a return game and made things look pretty bad during the first half. With the count 15-13 against them, the Badgers began to find the basket. Gibson, Farwell, and Elsom sank shot after shot and brought Wisconsin's total up to 36. Iowa was able to make only 11 points during the second half. They were lucky to have gotten one victory from us. There was no reason why they should have expected to get a second one.

Only Chicago remained to bar us from another conference championship. The Badgers put up a real battle against the Maroons. Chicago started off with a 7-3 lead, but that was about as far as they got. No team could have beaten us after Farwell, Gibson, and Wackman began to shoot baskets from every conceivable angle. Gibby and his teammates were out to win the game, and Barnes, Dickson and Co. soon discovered that their best was not good enough to stop the onrush of the Badgers. The 36-14 victory, which resulted from Wisconsin's phenomenal playing, put us into a triple tie with Chicago and Illinois for championship honors, —each team having won eight games and lost four. Captain Gibson and his men deserve no inconsiderable amount of credit for the uphill fight that they made.

Two men on the basketball team have played their last game for Wisconsin. Captain Gibson and Kady Farwell are both seniors and will be lost to the Badger squad next year. "Kady", who furnished the surprise package of the year, is an engineer. He started out as a substitute, but Meanwell soon found out that Kady was a fighter from start to finish. Consequently he soon began to appear in the regular's lineup, and he played no small part in the games which demonstrated that Wisconsin was of championship calibre. His loss will be very keenly felt by the team next year.

Despite the serious loss of Farwell and Gibson, Meanwell will doubtless turn out another strong team with the material that is left. Marshall Diebold, the captain-elect of next year's team, who by his steady playing was mentioned on many conference fives, will be back with Barwig, Wackman, Spooner, and Varney to help Meanwell put Wisconsin on the map again. Elsom does not expect to return to Wisconsin next year.

GYM

Coach Schlatter's gym team was distinctly a two man team. The two men were Captain Stevens and H. Schmidt, m. e. '25. In all of the gym meets Stevens and Schmidt took care of their part of the program and did the job well, but they could not win the meets unaided. Chicago with a well balanced team clearly demonstrated that a team made up of one or two stars could not hope to win against one made up of numerous "lesser lights". Although Wisconsin took four out of five first places, the Maroons by placing second and third won the meet 807.5 to 707. Schmidt took three first places,—the horizontal bars, parallels, and the flying rings, while Stevens obtained the judges decision in the side horse.

"HUCK"

At Minnesota the same thing occurred and we came home with the smaller side of the score on our side. After losing to Minnesota the Badgers took a trip to Chicago to see what two stars could do at a conference meet. Huck Schmidt, showing almost perfect form, was crowned all-around champion,—a title which he well deserved for his brilliant work throughout the year. Schmidt took second place in both the parallel bars and the rings at the meet, and Captain Stevens placed second in his favorite event, the side horse. Remhold's second place with the sabers, combined with the work of Schmidt and Stevens, gave us fourth place in the meet,—not so bad for a team which had been hampered throughout the year by lack of material.

In winning the all-around championship Huck Schmidt demonstrated his ability in all of his events. The winning of the championship resulted from months of hard work in the gym, and Huck certainly deserves all of the credit he obtained. Next year with a few experienced men helping him, Schmidt should bring Wisconsin to the front.

TRACK

After beating Iowa in a dual meet and taking the quadrangular meet with Chicago, Ohio, and Northwestern, the track team was ready to do its "stuff" in the Illinois Relays and the indoor conference meet.

The Illinois Relays gave Coach Jones' boys a chance to compete against the cream of the western track world. By taking third place in both the four mile and the one mile relays, the Badgers again gave evidence of having a well balanced team in the field. McAndrews, who was expected to place high in the 75 yard dash because of his victory over Brookins in the Iowa meet, was too anxious and was disqualified after he had jumped the gun three times. However the Badger speedster came back in the 300 yard dash and placed second. Muzzy took a fourth place in the broad jump in which Hubbard broke the old carnival record.

Captain Bill Hammann, who last year placed second in the relays, repeated his good work by again taking second. Bill almost deserved a first place, but was beaten out in his own event, the pole vault. In the recent relay carnival at the annex Bill showed the rooters what he could do with a little piece of bamboo in his hand by tying Don Jones' annex record of 12 feet 8 inches. Krieger, who persists in being ineligible, succeeded in going over the bar at 12 feet 5 inches.

After the good showing at the relays, Wisconsin went down to South Bend to take on the Irish. The Hoosiers showed a wild burst of speed and beat the Badgers in the final dual meet of the season. The Notre Dame meet, like the Iowa meet, was decided by the relay. However, instead of winning in the last minute at Notre Dame, as in the Iowa meet, we lost, when one of the "Irishers" broke the tape just ahead of Menke.

The last event on the calendar of the indoor track season was the conference meet at Evanston. Illinois with a team of real stars easily took the meet by scoring 39⅓ points. Wisconsin with a team which had been robbed of a few of its good men by sickness and injury had to be content with 2⅓ points. At that we beat Purdue. The Boilermakers who ran a solid goose egg score had to be content with nothing but their name printed in the final standings. To create more interest in track, the relay carnival was held a week after the conference meet. The 1924 carnival gave everyone a chance to place in the events. In the special events all of the newcomers were given a handicap to put them on a par with the veterans.

The relay carnival sounded the death knell of indoor track for this season. Tom Jones and Meade Burke will soon have their proteges performing regularly at Camp Randall where with good training the team should be able to condition themselves for a successful outdoor season.

GOOD LIGHTING OF INDUSTRIAL PLANTS SECURES SAFETY AND EFFICIENCY.

The Code of Lighting for factories, mills and other work places of the State of New Jersey makes excellent recommendations of daylight for the proper lighting of industrial buildings.

Adequate daylight facilities through large window areas, together with light, cheerful surroundings, are highly desirable and necessary features in every work place, and they should be supplied through the necessary channels, not only from the humane standpoint, but also from the viewpoint of maximum plant efficiency.

Importance of Daylight.

The unusual attention to gas and electric lighting in factories, mills and other work places during the past few years; the perfection of various lamps and auxiliaries, by means of which an improved quality and quantity of lighting effects are obtained; and the care which has been devoted to increasing the efficiency in various industrial apparatus—all go to emphasize the many advantages and economies that result from vital and adequate window space, as a means for daylight in the proper quantities, and in the right direction during those portions of the day when it is available.

Three Considerations.

Three important considerations of any lighting method are sufficiency, continuity and diffusion, with respect to the daylight illumination of interiors. Sufficiency demands adequate window area; continuity requires (a) large enough window area for use on reasonably dark days, (b) means for reducing the illumination when excessive, due to direct sunshine, and supplementing lighting equipment for use on particularly dark days, and especially towards the close of winter days, (c) diffusion demands interior decorations that are as light in color as practicable for ceilings and upper portions of walls, and of a dull or matt finish, in order that the light which enters the windows or that which is produced by lamps may not be absorbed and lost on the first object that it strikes; but that it may be returned by reflection and thus be used over and over again.

Diffusion also requires that the various sources of light, whether windows, skylights or lamps, be well distributed about the space to be lighted. Light colored surroundings as here suggested result in marked economy, but their main object is perhaps not so much economy as to obtain results that will be satisfactory to the human eye.

Requirements for natural lighting:

1. The light should be adequate for each employe.
2. The windows should be so spaced and located that daylight is fairly uniform over the working area.
3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.
4. The windows should provide a quality of daylight which will avoid a glare, due to the sun's rays, and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.

As will be noticed in the above recommendations, large windows and proper diffusion of daylight are urged, in order to meet the demands of daylight lighting.

Shades may be eliminated and most efficient lighting obtained by the use of Factrolite Glass.

If interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago

No. 7.

CAMPUS NOTES

L. C. Crew

Eta Kappa Nu, honorary electrical engineering fraternity, announces the election to membership, on Friday, March 28, of the following men:

Stephen C. Andreae
Erwin R. Summers
Reginald R. Benedict
Harry P. Dupuis
Eugene Bergholz
Earl M. Plettner
Floyd I. Fairman
Melvin A. Thomas

Mr. Herman Von Schrenck, consulting engineer with the New York Central Lines, gave a talk in the Engineering Auditorium, March 19, on the subject, "Preserved Timber as an Engineering Material." His talk was one of the best of the year.

The Stowell Company, operating foundries in Milwaukee and in South Milwaukee, offered the sum of $1500 to the Regents for the creation of a research fellowship in Metallurgy. The offer was accepted, and Clarence Lorig has been awarded the fellowship. The major problem that Mr. Lorig will investigate is the rate of the reactions in the malleable annealing furnace.

The second annual convention of the Wisconsin Utilities Association was held at Milwaukee, April 17 and 18. A number of papers by members of the faculty were presented. Professor O. L. Kowalke and Mr. R. L. Rundorff gave a paper on "The Removal of Naphthalene by Washing with Gas Oils." A report of the studies conducted under the electrical fellowship established by the Association was read by Professor Bennett and R. E. Johnson. Two investigations have been carried out by the aid of this fellowship: "Experiments with Wave Filters" and "Tests on the Fynn-Weichsel Type of Motor." Professor Rood presented his report on the electric railway fellowship.

Mr. E. R. Stivers, instructor in railway engineering, and Lynn Busby had an argument in Railways 110 over a question of specifications. Mr. Stivers won the argument by saying, "Well, if you don't believe me, ask some other authority."

We suggest as a thesis the investigation of the mythical "outside work" that makes fifteen Hill credits equal to twenty Engineering credits.

The Mechanics department announces the addition to the faculty, on February 29, of Miss Shirley Margaret Wilson, daughter of Mr. and Mrs. D. M. Wilson. Miss Wilson was too busy playing with her fingers and toes to be interviewed. She said she hoped to come up to see us when she grew a little taller.

The Registrar has made no announcements concerning the course in Tie Counting given at the close of each semester. Those eligible will probably be notified by mail.

It seems that every nice little girl that comes over here to take up Civil Engineering never gets any further than the Deans Office. Those that do can't make it by the T. E. Department.

It was not 2600 years ago that Mac said: "Experience is the best teacher. Take Grampa's advice and let 'em alone."

Mr. D. J. Price, engineer of development work, Bureau of Chemistry, Department of Agriculture, lectured in the auditorium of the Engineering Building March 24, on "Dust Explosion Hazards."

WHAT'S IN A NAME?

Mr. Charles E. Skinner, assistant director of engineering at the Pittsburg plant of the Westinghouse Electric and Manufacturing Company, who addressed the junior and senior classes February 27, was headlined in the "Cardinal" as a "Noted Electrician". Mr. Skinner should count it a bit of luck that he was not heralded as a "Famous Plumber".

The April award of a terra cotta compass for the most remarkable scientific discovery goes to John C. Cooley, frosh mechanical, who discovered in his surveying researches that true east is N 85—38W.

YES, BUT IS EINSTEIN CORRECT?

"On some levels," writes Charlie Matthews, frosh civil, "a windage adjustment is necessary so that the wind will not affect the instrument." Well, why not? If Einstein is correct and light has mass and is affected by the attraction of gravity, why can't the line of sight be affected by the wind?

Absent minded prof. (visiting the Chicago Stockyards): "Will one of the men in the back of the room please raise a couple of windows?"

The Babcock & Wilcox Company of New York recently presented the Department of Mechanical Engineering with a new and complete set of lantern slides on their boiler and stoker equipment.

BOLL WEEVIL ECONOMICS

Mr. E. R. Stivers, of the railway engineering department, predicts that engineers salaries are going to rise as a result of the epidemic of boll weevil in the southern cotton fields. This is his line of reasoning: The boll weevil must be exterminated and calcium arsenate is the only thing that will do it; calcium arsenate is secured as a by-product of the concentrating of gold; in order to secure enough of the arsenate, gold mining must be greatly stimulated with a consequent increase in the supply of gold; as the supply of gold increases its value goes down and prices go up; as prices go up the salary scale must also increase; and there you are.

ST. PAT'S PARADE

Although the weather—running true to expectations—seemed determined to be as completely disagreeable as possible, everyone who witnessed the event agreed that the sons of St. Pat turned out March 29 for the best parade that ever stopped traffic on State Street. That the engineer's parade is a popular stunt may be judged from the fact that snow, slush, rain, and sleet failed to discourage the spectators.

Kenneth Bussey and his party, with transits, levels, rods and tapes, surveyed the route, while the "necessary" computations were performed with the assistance of a six foot slide-rule. Following the route thus laid out, St. Pat's band, recruited exclusively from the National Guard Band of the Irish Free State, made the well known welkin ring, reverberate, and resound with the Engineer's Anthem: "St. Patrick Was An Engineer." The crowd, keyed up to high expectations by these stirring strains, were not disappointed at the long line of floats that followed the band.

St. Pat rode in his carriage of state with no visible protection other than that of his guardian angel, who sat just back of him in the carriage and toyed with a generously proportioned club. However, a company of engineers, all of them World War veterans and sharpshooters of repute, were deployed on the roofs of the buildings along the line of march and instructed to shoot on sight any lawyers seen loitering in the vicinity of St. Pat's carriage. An added feature of the parade this year, was St. Pat's personal orchestra, a fife and drum corps.

Dennis Murphy, e'24, took the part of our patron Saint after defeating four other candidates for the honor. The zeal of the electricals, combined with the vote drawing power of so appropriate a name, carried Murphy to a decisive victory. He led his nearest rival McCoy, by about six thousand votes. Hayward, Lonergan and McCoy ran very close and were bunched at about fifty-nine thousand votes each. Votes were ten cents a hundred, and the fund thus raised went to defray the expenses of the parade.

The Madison Fire Department was the butt of a clever burlesque by Barker's group, and took first prize—a pressing ticket from the Service Cleaners—among the group floats. McCoy's group won second honors, and a carton of cigarettes from Lawrences, with their version of "The Corn Clinic". Third prize went to a float by Teckmeyer's group—"Westward Ho!"

Theta Chi took the large cup for the best fraternity or rooming-house float An engineer, garbed in resplendent habiliments and seated in a luxurious motor car bearing a placard lettered: "I took engineering,,' was followed by a weird mechanical contrivance of ancient origin in which two ragged "lawyers" rode. A smaller cup was awarded to the Baptist Students for their "Forensics" float.

Among the efforts of the student engineering societies, "Teapot Dome", by the A. I. Ch. E. won the judges decision. A box of cigars, presented by Morgans was the prize. The A. S. C. E. took second honors with their bathroom scene. The spectators were loud in their expressions of sympathy for the scantily clothed occupant of the tub who risked pneumonia to lend realism to the stunt. The Campus Restaurant donated the carton of cigarettes awarded this group. A more or less faithful miniature reproduction of "Mew-sick" Hall, from whose interior emanated much doleful and raucous cacophony, was entered by A. I. E. F. and won third place and a box of the Chocolate Shop's best candy. Merchandise from Karstens was awarded to A. S. M. E. for their float—"Mother's Vision". Altho it is humiliating, we must, for the sake of the completeness of the story, announce that THE WISCONSIN ENGINEER's attempt to get a laugh at the expense of both the "Lit" and the Badger was good for only fifth place. We won a box of socks donated by The Toggery Shop, and there is much argument as to who'll wear 'em.

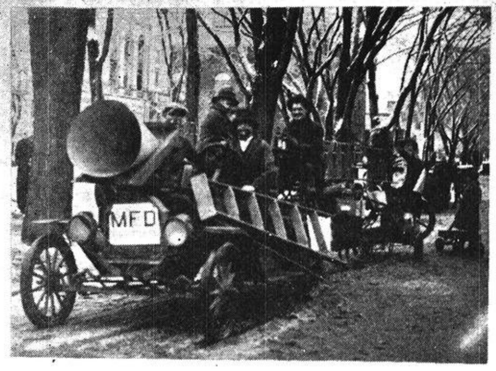
Among the individual stunts, Gregg and Kellefer placed first and won the slide-rule from the Co-op. Sogard and McCormack took second place with their "Mrs. N. Jineer and Kid." A month's pass to the Strand was the prize. The organ-grinder and monkey stunt put on by Odell and Baxandall won the pipe from Fisher Brothers awarded for third place. Unless they can arrive at some scheme for alternate smoking days, it is likely to be anything but a pipe of peace. A flashlight, the gift of the University Electric Co., was awarded to Carlson and Dupuis, and Harry Alberts' "Agric Cow" stunt won the laundry box offered by the Madison Leather Co.

A box of candy went to the frosh float—a take-off on Freshman English. The fife and drum Corps were given a box of cigars from Tiedemann's Pharmacy. Zaborowsky's burlesque of an "Hinglish Hinstructor from Hahvahd" won an Eversharp pencil.

Polygon deserves credit for the able manner in which it handled the St. Pat Campaign and the parade.

THE BLARNEY STONE

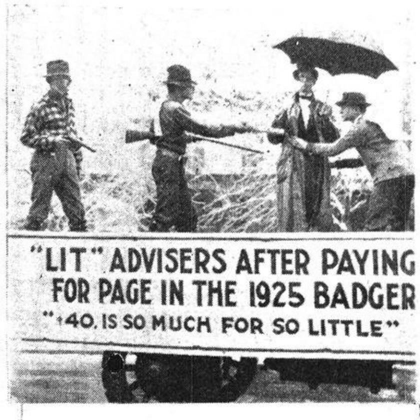
ST. PAT



A SHOT AT THE MADISON FIRE DEPT.

UNIVERSITY Y.M.C.A. FLOAT

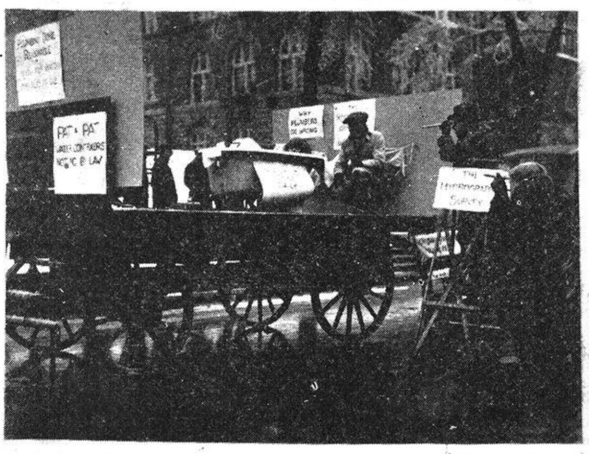
LAYING OUT THE ROUTE



WISCONSIN ENGINEER FLOAT

ST.PAT AND HIS LOYAL COHORTS

Fife and drum corps



THE A.S.C.E. FLOAT

SOGARD AND McCORMICK

ENGINEERING REVIEW

(Concluded from Page 144)

FELLOWSHIPS FOR COAL MINING RESEARCH WORK

A program of coal-mining research will be undertaken next year by the Carnegie Institute of Technology in co-operation with the Pittsburgh Station of the U. S. Bureau of Mines and an advisory board of coal-mine operators and engineers, according to an announcement just received.

A series of eight major problems covering research in geology, acid mine waters, coal mining, coalwashing, safety and efficiency, coal storage, and mine explosions has been tentatively outlined for investigation in 1924-5. Included in the program as announced are such studies as: Selection and performance of equipment for handling acid mine water; action of acid water on concrete and protective coatings; study of efficiency in blasting coal; study of possible substitutes for wood in mine timbering; friction losses and efficiency in mine ventilation; utilization and disposal of washery waste, and wet and dry methods in coal washing; smithing qualities of coal, a study of rock dusting; humidification of mine air; laboratory tests of relative tendency of coals to fire spontaneously; maximum safe storage temperature; static charges in coal mines; and the effect of the electric field in propagation of explosions.

Applications for the fellowships are now being received by E. S. Steidle, Supervisor of the Co-operative Mining Courses, at Carnegie Institute of Technology, Pittsburgh, Pa.

ELECTRIC CURRENT NOT DUTIABLE

The Treasury Department has reaffirmed its position that electric current from Canada is not dutiable. The original decision to this effect was written June 25, 1890, and has controlled the tariff acts enacted since.

IODINE TREATMENT OF WATER TO PREVENT GOITER

Since the city of Rochester, New York, first put sodium iodide in its water supply several cities have also tried the experiment. It is much too early to determine whether or not such a use of sodium iodide will aid in preventing goiter. Doctors and boards of health seem to be divided on the subject. It is claimed that a person who is susceptible to goiter does not receive sufficient treatment, and that others do not need the treatment. It is also claimed that chlorine used in the water has a tendency to decompose the sodium iodide, liberating iodine, the effect of which is not as favorable as that of its salt. It seems that it would be less expensive and more effective to treat the individual directly rather than medicate the entire water supply.

EDITORIALS

(Concluded from Page 140)

wise, he is not in a position to make an intelligent decision of the problems that arise in connection with his office There is only one way that a man can become thoroughly informed of the work, and that is by actually doing it and learning by practical detail just what the problem is that is awaiting decision. The time to learn this detail and to get this practical experience of the fundamentals of a business is when a man is young. If he does not get it then, he will probably never get it; and if a young man already equipped with a college training will do his utmost to learn all the fundamental details of the work that he has chosen, then his success is reasonably assured. The weakness of the college education is that it somehow gives the young man the impression that he does not have to begin at the bottom, and that the uninteresting details that can only be mastered by hard work and persistent effort can be left to the uneducated fellow who is not fortunate enough to be sent to college."

The above criticism of the college trained man should be of especial interest, coming as it does from the head of a large organization whose opportunities for observation have been particularly rich.

ALUMNI NOTES

(Continued from Page 142)

D. B. Masters, with the Consumers Power Co., Jackson, Michigan.

A. M. Obriecht, with the Illinois Central R. R., at Chicago.

P. H. Peterman, with the Public Service Co., Menominee, Wisconsin.

John Rian, with the Northern Indiana Gas and Electric Company.

R. H. Scholes, with the Public Service Co. of Northern Illinois, at Waukegan, Ill.

J. S. Timmons, with the Westinghouse Electric Co., at East Pittsburg, Penn.

MECHANICALS

C. H. Casberg, m '16, is superintendent of the machine laboratory at the University of Illinois.

H. K. Dean, m '21, who is with the Fuller-Lehigh Company at Fullerton, Penn., writes:

"I received the College of Engineering alumni directory the other day and was indeed very interested to go through it and see where some of the men I knew have landed. Being so far away from Madison now after having been able to run out occasionally over the week end, makes news of this kind extremely interesting. I used to think that all this stuff about longing for alma mater was hokum, but have changed my views."

Montrose K. Drewry, m '22, former editor of the WISCONSIN ENGINEER, has left the employ of Allis-Chalmers Co. to take a position as test engineer of power plants for T. M. E. R. & L. Co., of Milwaukee.

Paul Huntzicker, m '19, is an engineer with the H. L. Doherty Co., at Boulder, Colo.

L. T. Knocke, m '17, is teaching at Purdue University. His address is 707 Vine St., La Fayette, Ind.

J. B. Leonard and **T. C. Nichols**, both m '24, are with the American Blower Co., at Detroit, Mich. Their address is 71 Medbury Ave.

Rudolph Michel, m '16, is an instructor in drawing at the University of Illinois.

A. J. Nerad, m '23, who is with the General Electric Co. at Schenectady, N. Y., was at the University from March 3-8 lining up new men for the company.

W. D. O'Connor, m '22, is in the radio business at Hancock, Wis.

Raymond Porter, m '17, is with the U. S. Air Service at McCook Field, Dayton, Ohio.

Frank Saridakis, m '04, gives his address as 37 W. Van Buren St., Chicago.

Gustav Slezak, m '22, is a development engineer with the Western Electric Co., Hawthorne Station, Chicago, Ill.

J. T. Strate, m '21, is teaching mechanical engineering at the University of Texas.

COMMERCIAL ALUMINUM ALLOYS

(Concluded from Page 139)

ductivity makes it useful in coolers and distillery apparatus.

The most outstanding example of the aluminum alloys of the second group are the aluminum bronzes. The most useful of these alloys is one containing 11 per cent aluminum and 89 per cent copper. Its physical properties are similar to those of a 0.35 per cent carbon steel. It withstands corrosion very well and is especially well adapted to alternating stresses. Aluminum is often used as a partial substitute for zinc in brass, one part of aluminum being equivalent to 3.5 parts of zinc. The addition of aluminum increases the hardness and density and reduces the ductility. Brass containing aluminum cannot be remelted because the aluminum oxidizes and increases the porosjty of the brass.

The third group of aluminum alloys includes alloys of aluminum with cerium, neodymium, zirconium, beryllium, and tantalum. Aluminum with less than one per cent of these metals results in alloys having remarkable properties.

Many aluminum alloys for which great claims have been made have been prepared. Alloy literature mentions ormiston, albidur, antherium, electromental, ziskon, magnalite, and others. Thousands of alloys of aluminum with zinc, antimony, copper, lead, silver, tin, cadmium, magnesium, manganese, and other metals have been prepared and studied. Many of them were total failures, while others proved suitable for casting and had desirable properties. The theortical alloying of aluminum is fascinating because it is impossible to theorize or to account for the peculiar behavior of other metals with aluminum. Aluminum and its alloys deserve the attention of engineers because they are bound to play an ever increasing role in the future and offer a boundless field for materials of construction.

RECENT DEVELOPMENTS IN STREET LIGHTING

(Continued from Page 137)

increasing the night traffic and reducing the day congestion. It would permit of safe higher general running speed, thus reducing the running time and increasing the road capacity. Besides these advantages, such wiring of our highways would introduce secondary power transmission lines, as well, and help bring electric light and power to nearby farms, raising the value of the farm property and making life upon these farms more attractive. A number of places are already trying this new lighting with very satisfactory results. A one-mile installation of twenty 400 candle-power lamps has recently been given a trial on the highway between Kenosha and Racine. This new experiment may mark the beginning of a tremendous expansion in the lighting of our main highways. The possibilities in it are almost beyond belief.

A new and very effective type of reflector fixture has been brought out for this lighting. It restricts the light directly to the road, allowing little or none to shine outside, where it is not needed, and is designed to prevent glare in the eyes of the driver. The lamp candle-power is commonly 250 to 400; the height of suspension, 25 to 35 or 40 feet; the distance between the lamps, 300 to 600 feet, the lamps usually being along one side of the road only. The lamp candle-power per foot length of highway will run from ⅓ to 1. The cost of construction will probably run from $0.50 to $1.00, or slightly over, per foot of highway, or, approximately, $2500 to $5500 per mile. With a concrete highway costing from $40,000 to $75,000 per mile, this is not a very considerable additional sum in view of the tremendously better utilization of the road which will result from its illumination. The first cost may be greatly reduced if there is already an electric railroad or suitable line running along the highway. The annual cost may run from five to thirty cents per foot of road, depending upon the spacing and upon other factors.

Street Lighting Charges

In the cities of the United States with populations of 5,000 to 10,000 the average street lighting charge per capita per annum is about 85 cents; from 10,000 to 20,000 population, 88 cents; 20,000 to 50,000, 79 cents; and from 50,000 to 100,000, 69 cents. The average for the United States is about 72 cents. In the middle west, taking into account centers of 5,000 population and over, the annual street lighting charge per capita per annum is: Minnesota, 61 cents; Iowa, 66 cents; Michigan, 80 cents; Indiana, 77 cents; Illinois, 69 cents, and Wisconsin, 80 cents. For every dollar of city tax the street lighting tax may run 2.8 cents to 4.8 cents. For really good street lighting the annual expenditure per capita should not be less than one dollar. Only nine states expend more than ninety cents and of these only four expend more than one dollar.

Resume

The arc light is losing ground. The unit candle-power is too great, the spacing too wide, and the hanging too high. The incandescent street lamp is being used in tremendously increasing numbers. It permits closer spacing, smaller units, and lower hanging. Its efficiency is being steadily improved. It can be had in standard 2500 candle power capacity. The mercury lamp in any form has not yet proven satisfactory for street lighting service. A satisfactory gaseous glow lamp should be better than any arc or incandescent lamp and should supplant them, but no effective light of this type has yet been brought out, and the improved filament incandescent lamp will probably be the chief type of street light for some years to come.

The one-light, lantern-type lamp post with parkway feeding cable is coming more and more to be the standard form of installation. The requirements of the different sections of a city differ greatly and should be so treated. In the outlying districts where the use of parkway cable and post lights would be impractical, the use of downward hung, series incandescent lamps, with reflectors and refractors, supported from the same poles that serve to carry the conductors, is probably the best construction available at present. A new method for lighting main highways is being tried out with promise of great success. It opens a tremendous field of possibilities.

At present the average expense per person per year in the United States for street lighting is 72 cents. Not ten states expend over one dollar per inhabitant per year. Not less than one dollar should properly be spent for really effective street lighting; nearer two dollars per inhabitant per annum would be better.

THE RELATION OF THE ENGINEERING SCHOOL TO INDUSTRY

(Continued from Page 134)

pure scientific research for the sake of discovery, the special field for the engineering college, as we view it, is the investigation of certain fairly definite problems and processes by experimentation, and the application of fundamental principles already known, with the object of arriving at a practical and economic solution. In common with the managers of industry it is our business to promote economic production, and in this work the engineering school desires to be as useful as it can to the manufacturing and construction industries of the state. In the samples given of the research work that has been undertaken, you will note that the problems are mostly of a rather fundamental and general character. And this is the sort of thing that seems to be best suited to our conditions, and that brings the most return for the time and money expended. Problems of research from our standpoint may perhaps be divided into three general classes:

1.—Problems of general interest to engineers and manufacturers, such as those relating to reinforced concrete and air-lift pumps.

2.—Problems relating to a particular industry, such as the gas manufacturers, electrical utilities, or steel casting industries.

3.—Problems of interest to particular individual establishments.

It is obviously those of the first two classes in which the engineering school is more especially interested, as they are likely to be of more practical value to the community at large, and it is in this type of work that there appears to be the best chance of co-operative work. Three fellowships are now being maintained by three sections of the Wisconsin Public Utilities Association: the Gas, Electrical, and Electric Railway sections. Graduate students are engaged on problems assigned by consultation between the faculty and representatives of the Association, and much promising work is being done along this line. A very considerable amount of assistance has also been rendered by numerous manufacturing companies in the supplying of material for studies coming under those two classes. The results of such studies are freely published by the University, and are available to all interested. It is hoped that other fellowships of this character may be established by other associations, and we believe that the small expenditures will be fully justified by the results. In these directions, also, the College has felt fully justified in spending moderate sums of money granted by the Regents for such work. The College is also glad to take up problems of the third class, namely, those pertaining to individual concerns, so far as time and space will permit, and when supported by the necessary funds for the payment of assistants and materials.

It may not be out of place to mention here a certain other type of work that occasionally arises, requiring the personal professional services of a member of the faculty, as, for example, as expert witness or as an engineering expert. This is an individual matter, and should be considered and paid for as professional service. We do not object to a moderate amount of such work on the part of members of the faculty. We think it does the men good and the school good.

Another class of work is frequently brought to the University laboratories that should be mentioned. This is the testing and analysis of materials or the testing of machines or plants. This work is largely routine, and has little or no educational value. It is generally the kind of service for which various commercial laboratories are well equipped, and which they can do as well as the university. This kind of work we are not interested in, and do not care to do, unless it happens that for the particular work required there are no satisfactory facilities elsewhere available. In that case, we are glad to be of service.

I have thus far spoken only of the research work of the engineering school, and have said nothing of its instructional duties. The latter is the more obvious part of its activities and needs little explanation. As a matter of fact, the research side receives less than 10% of the time and energy of the faculty, and its direct appropriation is less than 3% of the entire budget. In these days of rapid development in the application of science to industry, it is too small a proportion. It is out of balance with the purely instructional side of the work if the school is to be of the greatest value to the state, and it is partly for this reason that I have emphasized this phase of the work. I venture to say that in most of the first-class agricultural colleges of the country, the agricultural research accounts for at least 50% of the budgets of these colleges, and the work is heartily supported by the state and federal government. If I were to hazard a general estimate, I would say that a state engineering school should devote about 25% of its budget to research work, and this not only for the district benefits derived, but for its influence on the teachers and students. A good teacher continues to be a student, and needs to keep abreast of the times by taking part in the discovery and development of new things in his line of work. Advanced students preparing themselves for research careers can get their training only in departments which are active in this respect.

The teaching of the students who come to us is a large job. Engineering instruction is receiving a great amount of public attention these days, and engineering schools a lot of criticism from various directions. The engineering graduate is in great demand, and almost impossible things appear to be expected of the boys as they come from school. Engineering faculties are doubtless quite conservative in making changes, but they are seriously trying to do the best they can for the young men whom they are teaching. But things are getting more complex and demands more varied, and the problem needs more study. This is fully realized, and the national association of engineering teachers has, through a committee of its members, secured a fund of about $100,000 to be used in making a thorough study of this subject; and one of the Assistant Vice-Presidents of the American Telephone and Telegraph Company, a man who at one time was a student and instructor at the University of Wisconsin and later at the Massachusetts Institute of Technology, has been secured to direct the investigation. Some of you will doubtless be called upon, within the next year or so, to tell what sort of technical men, if any, may be most useful in the industry with which you are connected, and what sort of training is needed to produce the best results in the character and fitness of the graduates.

The training of young men is a serious matter, and at the University of Wisconsin it is your own sons that are largely involved. In engineering, it is especially true that this training does not stop at Commencement day. The employer's part is very important if the full value of technical training is to be realized. Great attention is being given by the larger concerns to the proper organization of their apprentice courses for technical graduates and in the selection of men for different kinds of work. Much more needs to be done, especially by employers whose experience with technical graduates is limited, and who hardly know what to expect or how to use the graduate advantageously.

The number of engineering students at the University is about 1100, and about 200 are being graduated each year. There are 129 engineering schools and departments in the United State, graduating about 5000 per year. The National Conference Board, in a report on Engineering Education and American Industry, estimates that the number of additional men needed in industry each year in positions where technical training is desirable is probably as high as 40,000. Jobs there are in plenty, and in confusing variety. The problem of the school is to adapt its instruction to promote the best interest of its graduates and of the social life of state and nation. Its graduates must for the most part do their work in engineering and industrial organizations, and it is vitally important to their welfare and to the advantage of industry that they find the place where they can do their best. The fitting of men to their jobs is of increasing importance and complexity. The schools greatly need the co-operation of industry. In the report above referred to, it is stated that "The responsibility of industry in connection with engineering education is much greater than has been realized heretofore," and " during the last period of engineering education and the first period of engineering practice, the engineering school and industry have a common problem," and points out the desirability of closer co-operation during this period.

The Engineering College is doing the best it can with the means available, but we are at a point where our support must be materially increased if we are to do our work right and make our proper contribution as a state engineering school. In general, we have no complaint to make in regard to teaching staff and funds for ordinary operation, but we greatly need more space for laboratories, more equipment and more funds for research. No more students can properly be taken care of in our laboratories, and advanced instruction and research work are practically out of the question in some departments. In particular, the steam and gas laboratories must have larger accomodations and added equipment before anything more than the undergraduate instruction can be given in this department. Considering the nature of the industries of this state, this is not a satisfactory condition.

And we greatly need more funds for research, especially for fellowships and scholarships. Some considerable progress is being made in the establishment of fellowships for special work through contributions, and we hope more will be forthcoming in the near future. But why should not the state make moderate contributions for this kind of work? In the state of Iowa, a thoroughly agricultural state, the Engineering Experiment Station receives a direct appropriation of $50,000 per year. Illinois gives its Engineering Department about $100,000 per year for experimental work. We believe this state should do more than it has in the past, and that it will do so if its manufacturing interests are convinced of the value of such work and give to it their support.

I have thus briefly set forth the work of the engineering school in its two phases, and to some degree their relation to industry. I am grateful for this opportunity. We need co-operation in order that we may do the most for the young men in our charge. We bespeak co-operation in the training of the young men while in school, in summer employment, and in their further education as employees under supervision. We also ask support in the research work of the college, directly and indirectly, in such ways as may be practicable. On the other hand, you may be assured that the engineering school is desirous of doing all it can to promote the industries of the state and welcomes suggestion whereby the service may be improved.