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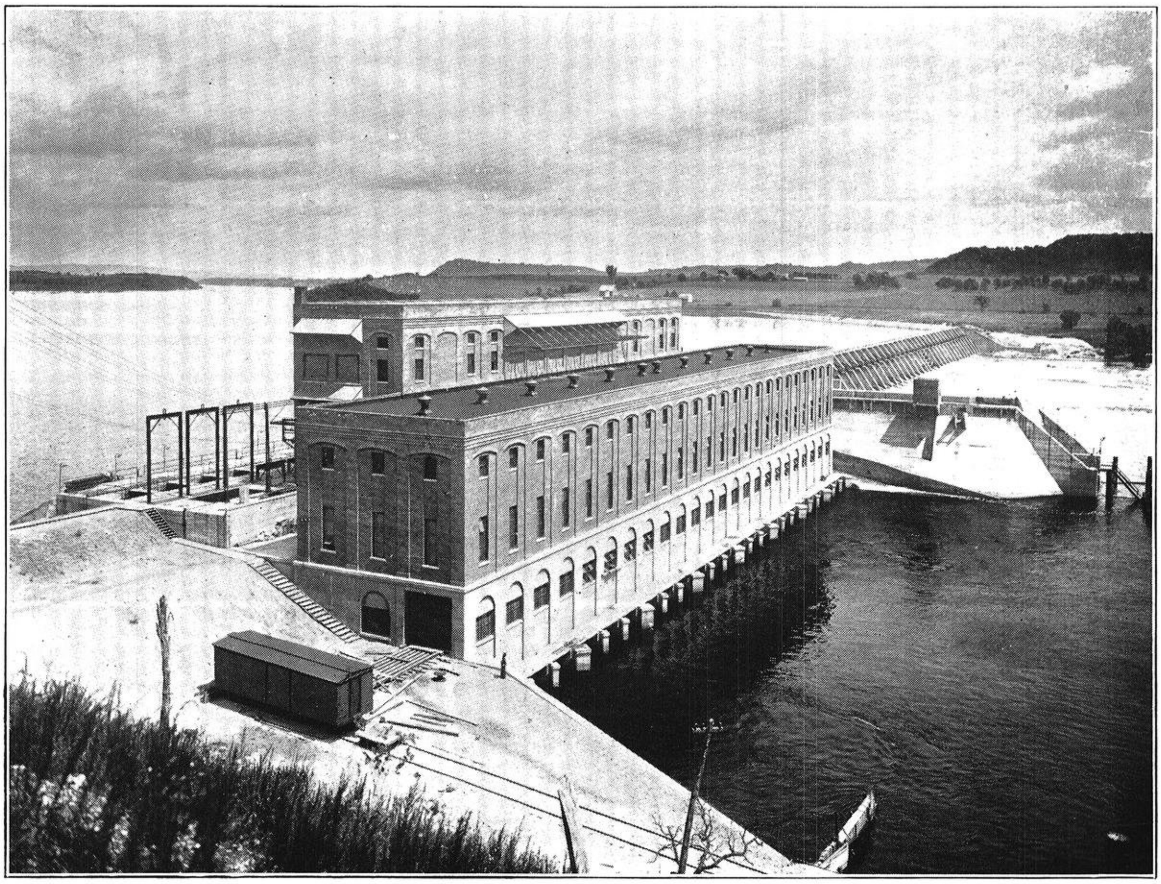
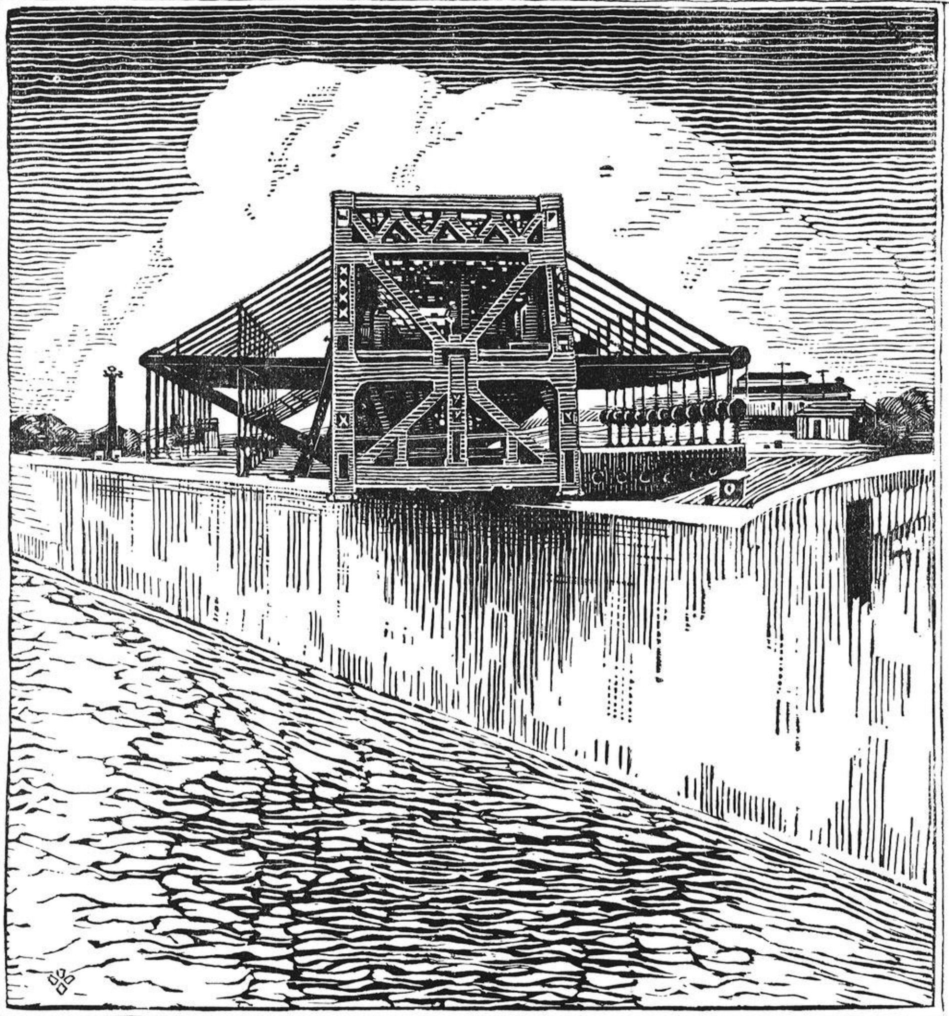


THE POWER PLANT AT PRAIRIE DU SAC



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UNIVERSITY OF WISCONSIN
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THE RAYMOND COMPOSITE PILE

By ALBERT E. CUMMINGS,* c '21.

Prior to the beginning of the present century practically all of the piling used for foundation purposes in this country was of wood. At times iron and screw piles were used as substitutes for wooden piling, but these were introduced in order to meet special conditions and they were not at all in general use.

Wooden piling, however, although relatively cheap, has several serious disadvantages. In order to prevent decay of wooden piles it was necessary to cut them off below permanent ground water level. This, of course, frequently required excessive amounts of excavation and correspondingly large amounts of masonry to bring the footings to grade. If the ground water level were in any way liable to future depression, there would be reasonable doubt as to the future integrity of the structure which the piles supported. Again, the amount of loading which could be applied safely on wooden piles was comparatively small.

These disadvantageous features of wooden piles caused engineers to search for a suitable substitute, and the general adoption of concrete as a building material soon led to its use as a means to take the place of wooden piling.

Concrete piling is usually divided into two distinct types, viz., "pre-cast" piles, which are cast on the surface and then driven into the ground, and "cast-in-place" piles which are cast in their final position after the necessary opening in the soil has been obtained by driving down temporary or permanent forms or shells. Each of these two types of pile has certain disadvantages. The precast pile is usually quite expensive and its use necessitates the provision of a large area of level ground for casting purposes somewhere near the site of the work. Again, although a precast pile can sometimes be driven, it is often jetted into the ground and this operation involves pumping machinery and a large supply of water. It may be noted, however, that precast piles a little more than a hundred feet long have been driven successfully, but the handling of concrete piles of this length is a delicate operation and their cost is exceedingly high. The greatest disadvantage of the cast-in-place pile is its limited length. The maximum length of this type of pile at the present time is about forty feet, which, of course, makes it useless in many places. The cast-in-place pile, however, has several advantages over the pre-cast pile in that it requires no large casting place and seldom has to be jetted into the ground. Pile for pile, the cost of any kind of a concrete pile is greater than that of a wooden pile, but concrete piles have two distinct advantages over wooden piles, viz., they are not affected by ground water levels, and they support greater loads than wooden piles.

It can be seen, therefore, that the development of a pile which would combine long lengths with low cost and permanence, would aid materially in the solution of many foundation problems. With this object in mind, engineers have developed what is known as the "composite pile" which consists essentially of a concrete pile superimposed upon a wooden pile, with the joint below permanent ground water level.

Among the first composite piles driven in this country were those placed in 1905 under the station platforms of the Hoboken, N. J., terminals of the Delaware, Lackawanna & Western Railroad. These piles were driven in the following manner: The wooden piles were driven until the heads of the piles were about a foot above the ground and then a square box consisting of two-inch planks eight feet long was constructed on the head of each pile. A wooden follower was inserted through this box and rested upon the head of the wooden pile. By means of a collar near the top of the follower, the square box was driven into the ground with the pile until the pile head was below ground level. The follower was then withdrawn and the box filled with concrete, thus insuring safety against decay of the wooden pile heads.

From time to time in different parts of the United States attempts were made to drive composite piles, but these piles were usually designed to suit the particular problem under consideration and the results obtained were not always entirely satisfactory. During the year 1916, the Raymond Concrete Pile Company of New York, undertook the development of what is now known as the Raymond Composite Pile. Remarkable success has been obtained with this pile in lengths ranging from forty to one hundred feet and large numbers of them have been driven in different parts of the country.

The Raymond Composite Pile consists essentially of the upper or heavier section of a standard Raymond Concrete Pile superimposed upon a wooden pile. The joint

*Mr. Cummings has been with the Raymond Concrete Pile Co. for a number of years and has taken an active part in the design, testing, and use of the composite pile.

between these two piles is carefully constructed and well reinforced and their relative lengths are such that when the composite pile is completed this joint is always below permanent ground water level.

When the wooden piles are delivered to the job, they are first unloaded in what is known as the "trimming yard". Here they are carefully selected as to size and straightness and the accepted piles are taken to the "heading machine". The principal parts of this machine are a set of rotating knives and a circular saw. The rotating knives trim the head of the wooden pile to a uniform diameter of nine and three-eighths inches over a length of nineteen or twenty inches, and the circular saw cuts off the top of this trimmed section so that a tenon is formed nine and three-eighths inches in diameter and eighteen inches long, the top surface of the tenon being perpendicular to the longitudinal axis of the pile. The headed pile is then returned to the trimming yard where four three-quarter inch holes twenty inches deep are drilled into the tenon. The pile is then ready for delivery to the pile driver.

Arrived at the pile driver, the wooden pile is hoisted into the leads and a specially constructed steel follower is fitted over the head of the pile. This follower fits snugly around and over the tenon so as to prevent crushing or "brooming" during driving. After the wooden pile has been driven into the ground to a depth such that the tenon and about a foot of the pile remain above the surface, (see Figure 1) the follower is removed and four five-eighths inch square twisted steel reinforcing bars forty inches long are driven twenty inches into the pile in the four thre-quarter inch holes previously drilled into the top of the tenon.

The concrete section of this pile is installed in much the same manner as the Standard Raymond Concrete Pile. A spirally reinforced steel shell with a plain steel "boot" at the bottom is placed on the outside of a collapsible steel mandrel or core, which tapers at the rate of four-tenths of an inch in diameter for each foot of its length. The bottom of this core is so constructed that it fits closely around and over the tenon of the wooden pile and the reinforcing rods extend up into the core. This combination is then driven farther into the ground until a proper penetration is secured and the top of the wooden pile is known to be below permanent ground water level. The core is then collapsed and withdrawn leaving the wooden pile with its reinforcing bars and the steel shell in the ground. After a careful inspection of the joint and the interior of the shell, a little cement grout is poured around the tenon of the wooden pile and the balance of the shell is then filled to cut-off grade with concrete.

In this manner a pile is obtained which is practically permanent. Another advantage of this kind of pile is that it can be driven in great lengths. Wooden piles have been driven as long as eighty feet and then topped off with twenty-two feet of concrete pile, making a total length of a little more than one hundred feet. The cost of composite piles is considerably less than that of all-concrete piles of equal lengths and the composite pile has all the advantages of an all-concrete pile in the saving of excavation, masonry, pumping, shoring, and other items.

The load allowed on composite piles is usually twenty-five tons per pile. There are many formulae in existence for calculating the bearing power of piles but the most common of these and the one most generally used by engineers is known as the Engineering News Formula, viz.:

$P = 2\,W\,h \div (s + .1)$ in which
P = safe load on pile in pounds.
W = weight of falling part of hammer in pounds.
h = distance of fall of hammer in feet.
s = final penetration in inches per blow.

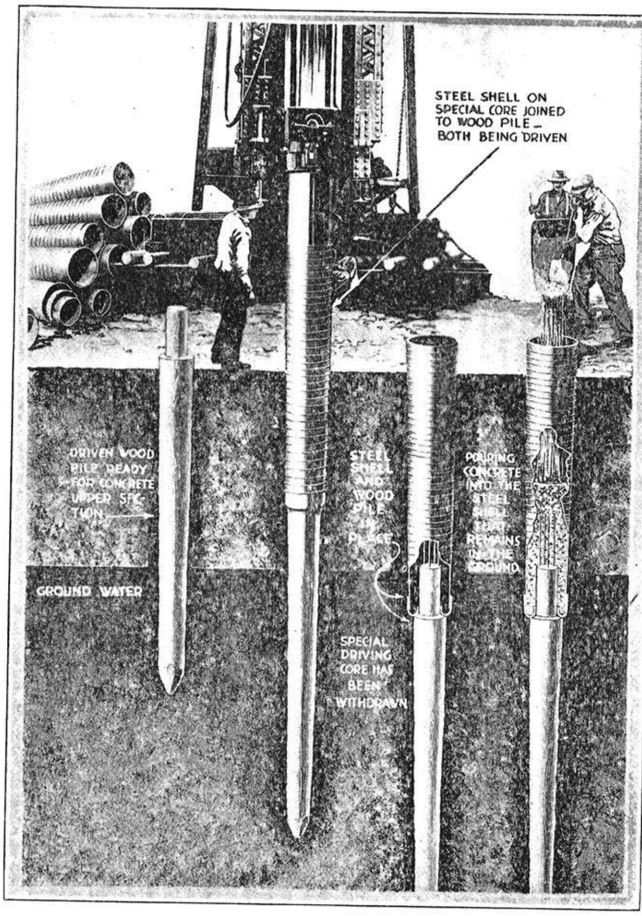


FIG. 1. DRIVING AND POURING A COMPOSITE PILE. *The wooden portion of the pile is comparatively cheap and can be driven in lengths great enough to secure the desired power. It must be cut off at ground water level in order to prevent decay. The upper portion of the pile is of concrete firmly anchored to the wooden portion.*

This formula applies only to steam hammers and it is supposed to contain a safety factor of six. In the event that a drop hammer is used the formula is written $P = 2\,W\,h \div (s + 1.)$ in which the letters have the same meaning as above and the safety factor is also six. All

Raymond Composite Piles are drive with a steam hammer having a ram weighing five thousand pounds and falling three feet, and driving is continued until a final penetration of one-quarter or one-third of an inch per blow is obtained. If these numbers are substituted in the formula it will be found that a pile so driven should be capable of safely supporting a load of from thirty-five to forty-five tons, and actual load tests in the field have proved that these piles will support even more than forty-five tons, with only a slight amount of settlement. However, in order to provide an additional safety factor and preclude the possibility of settlement, the maximum load placed on a composite pile is twenty-five tons.

Since the concrete portion of the Raymond Composite Pile is tapered, there is considerable friction set up between the sides of this concrete pile and the surrounding earth when the load is placed on the pile. The amount of this friction depends entirely on the nature of the soil into which the pile is driven, but the importance of this feature of the Raymond Composite Pile lies in the fact that an appreciable part of the total load which is placed on the composite pile will be transmitted to the surrounding soil by the tapered concrete section of the pile and the full twenty-five ton load very rarely reaches the head of the wooden pile.

The stresses developed in a pile due to the vertical load are not the only stresses to be taken care of. When a pile is being driven into the ground adjacent to piles already driven, certain indeterminate lateral stresses are set up in the surrounding soil which react on the piles already in the ground. There is also a possibility, especially in newly filled ground, of a lateral movement of the entire mass of soil under consideration and a consequent tendency to bend over or shear off any piles driven through this soil. These lateral stresses are of some importance no matter what type of pile is being considered, but they are especially important in the case of a composite pile where the joint is undoubtedly the critical section.

In determining the most desirable type of joint for a composite pile, there were two important factors to be given consideration: First, the joint must be strong enough to resist the stresses, vertical and lateral, which act upon it; and, second, the joint must be so constructed that its use would not involve too many complicated operations in the field.

In order to determine the relative strengths of various types of composite pile joints, some actual load tests were made on different kinds of composite piles at the shops of the Raymond Concrete Pile Comany at Harvey, Illinois. Several different types of joints were designed and full size composite piles of each type were made. These piles were loaded and tested in several ways: As unsupported columns over a length of forty-five feet; as simple beams over spans of various lengths; and as cantilever beams. The loads and deflections and other test data were recorded and from these data calculations were made to determine the stresses which existed in the various parts of the joints at the ultimate loads. A careful examination of these results demonstrated that the type of joint described above was strong enough and rigid enough to withstand the forces which might be expected to act upon it in the field and it was also the strongest, the most rigid, and the most economical of the joints tested.

In addition to these shop tests, a number of load tests have been made in the field on composite piles of various lengths. The usual method of testing in the field is to allow the concrete in the upper part of the pile about ten

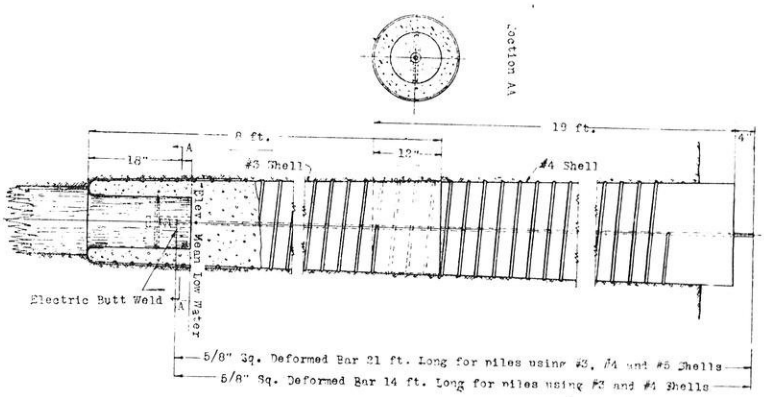


FIG. 2. DETAIL OF THE COMPOSITE PILE. *This illustrates the most recent of several types of joint between the two portions of the pile. A steel shell is attached to the wooden pile and is driven with it. A long rod is screwed into the top of the wooden pile and serves to hold the concrete to the wood. The concrete is poured after the pile is in place and the rod has been attached.*

days in which to set up and then to construct on top of the pile a box or platform onto which some heavy material can be placed. The test load is usually increased in five-ton increments and level readings are taken at intervals to determine whether or not the pile is settling. Raymond Composite Piles have frequently been tested in this manner up to fifty and sixty tons of load per pile with only slight amounts of settlement and the results of a number of such tests have proved conclusively that the pile will safely carry twenty-five tons.

As the Raymond Composite Pile came more and more into general use, various improvements and new developments were made. Some of these changes were directed toward simplifying the actual field work and their object was to improve the method of handling and placing the piles and to decrease the cost of the various operations. They affected principally the mechanical details of the pile cores and the method of handling and placing the reinforcement. Other changes have had for their purpose the improvement of the design of the joint itself. The most recent type of joint is shown in Figure 2 and in this joint the four short reinforcing bars are

(Concluded on page 152.)

THE BRAKES ON AMERICAN AND EUROPEAN MOTOR CARS

NED KROTZ,
Senior Mechanical.

For years it has been the accepted practice to depreciate American effort where mere quantity or bulk of results was not the only criterion. Perhaps the most graceful way out of such a situation is to admit that we are a bit new, and certainly not so effete as the Europeans.

We need not feel badly about that, however. The real European—perhaps Bernard Shaw's "good European"—considers even the Englishman who stays the year through on his island as something of a provincial.

The fact is that anyone who does not spend an occasional season at the Continental watering places, and take a trip now and then to the Riviera, is a bit out of the running. It is the intimate contact with so many peoples of different fundamental characteristics and different ideas that evolves most of our newest fads and fashions and, occasionally, some really progressive ideas. However, with contantly improving transportation and communication, provincialism is coming to be more nearly a state of mind than an attribute of environment.

We certainly are cutting down Europe's lead in the Automotive world, and their lessened prestige together with the spectre of increased American competition causes our European and English friends to sieze upon any real shortcomings with ill concealed joy.

Of all the criticism of our cars the one most universally heralded weakness is our braking systems. This and excessive fuel consumption have cut our exports to at least half the value of shipments we could make without these faults.

For some time the tendency in Europe has been toward high speed motoring, but not as we do it here, furtively and with ears and eyes alert for motor-cycle police, or a possible speed trap. The police there are more concerned with what is a "reasonable" speed under the existing circumstances than they are with any arbitrary standard, and their idea of reasonable speed would probably be about double the speed we should use here.

These conditions have brought more attention to braking systems, and just at present the brakes are receiving as much or more attention than any other feature of continental chassis. Even England has lagged behind in this development and it is not surprising if we are still farther in arrears in our brake development.

Most of our roads have no steep gradients; our average motoring speeds are low; and our cars are more notable for ease of production and cheapness than for fine engineering details. We have some splendid engineering departments, but on the whole the howling screech of burnt linings or poorly designed or adjusted brakes which we hear so often is an eloquent comment on our braking practices. There are extremely few of our cars with brakes that will stand a trip through the mountains without constantly using the motor and low gear as a brake.

We can certainly do much toward improving our present conventional systems before we are ready to try out the more or less new ideas. This is largely routine work, however, and involves more careful layout and more attention to cooling and uniform pressure on the braking surfaces.

The really important innovations in this field, besides cleaning up of existing designs, are brakes on all four wheels and the servo-brake.

The front wheel brake has been struggling for recognition for years, and is getting it with a vengeance just now. We have recognized the desirability of rapid acceleration for a long time, and we are just beginning to realize that deceleration is still more important.

M. Henri Perrot, who was engineer for the British Argyll, has probably done more than any one else to develop front wheel brakes, although the Isotti-Franchini Co. has done a good deal of work. Practically every European chassis of note now fits front wheel brakes of one of these two types. The chief exceptions are Voisin, Slim, Bugatti and Rolland Pilan in Europe, and the American Duesenberg which won the French Grand Prix last year, all of which are fitted with some form of hydraulic or pneumatic front wheel brakes. Incidentally the makers of the Rolland Pilan claim priority with this type of brake and there has been talk of taking action against Duesenberg, who seems to have a vastly superior system.

If we assume that a four-wheel brake system is worked out to take hold smoothly, to be reasonably free from overheating and to require a pedal pressure within a reasonable maximum, the question of what is gained by adding a servo-brake may be asked.

To begin with, finer cars have set the example, now followed by many cheaper models, of requiring only a nominal effort to operate the clutch and brake. This can be done at lower speeds, but most of us have found that at higher speeds an increasing effort is required to get maximum braking effect. There are cars, especially cars with Hutchkiss drive, on which the brake arm centers are so laid out that at high speeds the torque reaction from the first application of the brakes causes a further momentary tightening of the brakes and results in locking the wheels, with consequent loss of adhesion to the road. It is fairly well established, however, that a higher unit pressure on the brake lining is required at high speed to give maximum braking effect. The only adequate explanation of this seems to be that the coefficient of friction varies inversely as the speed, probably because of the larger amounts of heat generated. Experiments are now being carried on with a Chenard-Walcker car to investigate this phenomenon.

The object of the servo-brake is, then, first, to use

(Concluded on page 148.)

SUCCESSFUL WISCONSIN ENGINEERS — WILLIAM S. HARLEY

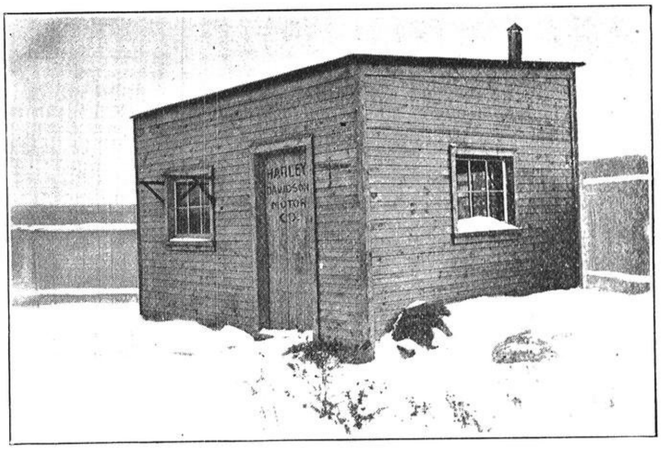
By R. B. Bohman.

WILLIAM S. HARLEY

The story of the career of William S. Harley, which, in reality, began before he entered college, is a striking illustration of the fact that the man who knows that he possesses a sound and fundamental idea, and has the courage to put the plans of it into effect, has practically unlimited opportunities at his command.

Mr. Harley was born at Milwaukee, Wisconsin, in 1881, and was graduated from the University of Wisconsin in June, 1907, with the degree of bachelor of science in mechanical engineering. Today he is treasurer and chief engineer of the Harley Davidson Motor Company, the largest manufacturers of motor- and their accessories in the world.

Together with the Davidson brothers, Harley had experimented on his "self-propelled bicycle" for some time prior to his entering the University. In fact, the idea prompting him to come to college was the fact that, in his study of gas engine, he realized how hazy his notions of its operating theories were. Previous to this time, he obtained his first knowledge of mechanical work in a machine shop. After serving his apprenticeship, he became a draftsman, which position he held up to the time of his entering college. Coincident with his daily work, he and his chum, Arthur Davidson, had, in odd hours, been developing their motorcycle, with Harley acting in the capacity of draftsman and designer, and Davidson as the patternmaker and machinist. It was at this time that Harley gave up his work as a draftsman and entered the University. While in attendance here, he worked his way through school by waiting on tables, working in an architect's office, and in constructing psychological apparatus for Professor Jastrow, in the department of psychology. At the same time, Harley tended to the complete designing work of the motorcycle development which was being carried on in Milwaukee by his partners.



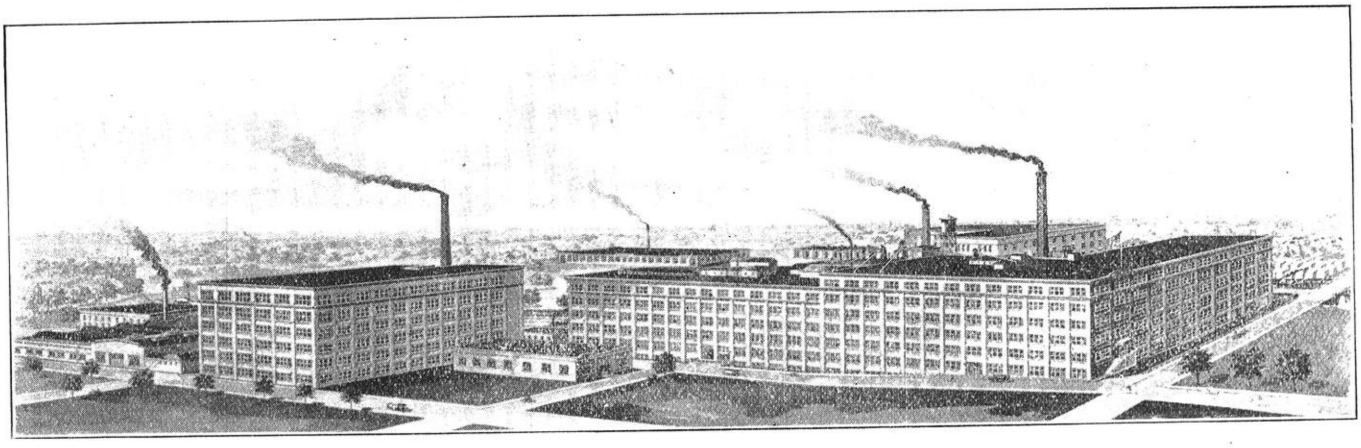
FIRST HOME OF THE HARLEY DAVIDSON CO.

Development in a dozen years from the above "factory" to the largest of its kind in the world followed Mr. Harley's graduation from the University.

It is rather interesting to note that at the time he came to school to study more about gas engineering, the only course given in that subject was a three-fifths elective by Professor Thorkelson, former business manager of the University, and then head of the department of steam engineering. The laboratory equipment at that time contained hardly any gas engines.

In his senior year, Harley was one of a group of students elected to make an eleven day test on a new steam turbine for the Commonwealth Edison Company, at Chicago.

When Harley graduated in 1907, the infant motorcycle organization boasted of a personnel of fifteen employees. In the next year the company incorporated.



THE HARLEY DAVIDSON PLANT OF TODAY

Early experiments on the "self-propelled bicycle" prompted Mr. Harley to enter Wisconsin's engineering course in order that he might prepare for its development.

But business prospects were not as promising at the outset as the reader may imagine, for, about this time, the problem of obtaining sufficient capital for their increasing requirements was a serious question. As a result, Harley, for a time, found it more profitable to work as a checker in a bridge works in order to help secure the money needed to carry on the work of improving their machine.

After the financial difficulties of that period were disposed of, the new business began to develop rapidly, and from 1908 to the present time the company has grown steadily until it is now the leading one of its kind in the world. Beginning with a force of 15 workers, the company now has between 2500 and 3000 employees on its payroll. From the little shop the plant has expanded to its present enormous size as illustrated. The company had its biggest year in 1917, when 27,000 complete machines were turned over to the government for war purposes. This was under forced production, however, their normal output being about 20,000 machines per year. Due to the specialized character of the motorcycle industry, the company is obliged to manufacture a large variety and number of accessories in addition to their normal machine output.

Mr. Harley, in addition to perfecting a complete modern starting and lighting system for motorcycles, and introducing many novel improvements in the design and operation of motorcycles, has also been very active in work not directly connected with his own interests. He is a member of the Society of Automotive Engineers, in which society he is chairman of the committee on motorcycles. During the recent war, he was at the head of a committee appointed by the War Industries Board, composed of representatives of the leading motorcycle manufacturers, and formed for the purpose of designing and constructing a completely standardized motorcycle for use in military operations. Shortly after the armistice was signed, this committee was disbanded before the desired plans had been carried to completion.

Mr. Harley has a very definite idea regarding the manner in which an engineering student may profitably spend his spare time. He believes that any ability acquired through practice in public speaking eventually proves a valuable asset for any one who plans to engage in an engineering or business career. This opinion is the result of Mr. Harley's experience, as his activities have gradually turned from the engineering to the administrative development of his company.

"Scholarship has a very definite value as an index of ability. It shows that a young man or woman, without immediate economic necessity, has been able to concentrate attention on the principal duties to be fulfilled in the midst of many competing interests and districtions. Having done this task well creates a positive presumption in favor of future success in other realms of responsibility." (W. E. Wickenden, A. T. & T. Co.)

TUNE IN!

Tune in! Wisconsin calls today.
Song and lecture, without pay,
She sends by wireless, through the air;
So tune in and with her share
The lore of ancient days, forsooth,
With news of modern search for truth.

Word went forth from Galilee
That the truth should make men free;
And with patience through the ages
Has the scholar read the pages
Of God's truth. From distant stars,
From hist'ry of man's frightful wars,
From storied stone and flower and fern
And book of childhood would he learn;
In everything he sought to find
The laws of matter and of mind.
He dreamed that all might know the joy
Of growth and service and employ
Their faculties to help create,
For themselves and for the state,
That ideal community
Where truth is known that makes men free.

To grow and serve Wisconsin's aim;
'Tis this has brought her world wide fame.
Her children know they need but ask
For help to meet the daily task.
She plans for health and beauty, too,
And recreation that shall woo
The toiler from his sense of care;
And now the distant sick-room chair
She seeks to bless,—by wireless fleet
The suff'rer shares a music sweet
As mating song of mocking bird
At peaceful hour of midnight heard.

Today the clarion call, "Tune in!"
Resounds in far-off, old Pekin,
Where Princeton, Pennsylvania, Yale,
Wisconsin, Harvard, tell a tale
Of growth and service, and all see
Them live the truth that makes men free.
The Orient awakes and hears
The call that dissipates her fears,—
Her fears of famines and of floods
And ancient fears of ancient gods.

Shall we at home now faithless be,
While studying sociology?
Do shades of Royce and James agree
On questions of psychology?
Methinks behind the veil, so thin,
They're calling now, "Tune in! Tune in!"

J. U.

An engineering curiosity, said to be unique in this country and to have only one parallel in Europe, is the pipe arch bridge over the Sudbury river, which carries Boston's water supply. The span is 80 feet, and the steel pipe, 7½ feet in diameter, rises 5½ feet above the horizontal at the center. The pressure on the abutments when the pipe is filled with water is great and is resisted by a mass of concrete 40 feet thick behind each abutment. Across the curved top runs a hand railed foot bridge. The steel of the pipe in the arched portion is five-eighths of an inch in thickness.

ENGINEERING FOR GENERAL EDUCATION

By JOHN G. D. MACK,
State Chief Engineer.

"An engineering course offers an excellent opportunity for the somewhat intangible thing known as a general or liberal education," says State Chief Engineer Mack.

One of my boyhood friends, almost from the time he learned to read, had his mind fixed on what his vocation was to be when he was grown up. He was going to be a printer. Just why he had this one idea I do not know, for there were no printers in his family. In this determination he never wavered. As soon as he could use tools he made presses of wood, saved money and bought some type and thus saw his own work on paper. Later he got employment with a job printer, became an expert typesetter and mastered the linotype when it came out. The next step was to invest his savings in a small job printing shop which grew until he is now the owner of a large printing establishment in a great business center. His case seems to have been one of rather happy destiny for he never had to worry about what line he was to follow.

Selecting a Vocation

Cases like this are very rare, and most boys have had many fleeting ambitions about their future business or profession. Almost every one who reads this can recall such dreams, doubtless the most universal of all having been to be proprietor of a candy store.

Another method of selection is for a boy to follow his father's profession or business, although out of the total I believe this number to be of relativcly small proportion. There are probably several reasons why a large number of boys do not follow in the footsteps of their fathers, among which are the rapidly increasing number of vocations, and the inherent pioneer spirit of the young men to try something new.

It is quite likely that among the large majority of boys really definite future plans do not begin to form until they are of high school age, fourteen to eighteen, and often not until later.

I believe it is not generally best to make the selection of one's life work too early, for there are many fields of knowledge, and, still speaking in general terms, early specialization is not advisable and oftentimes is warping in its effects. If there is doubt, the young man should survey the "activities of the world" before making a decision. There is no loss of time in this, nor is there a loss of effort. In spite of the seeming sharp cleavage between modern activities, knowledge is cooperative in the broadest sense, and any one of these unnumbered activities is constantly drawing on many others to aid in its progress, although at first glance there may seem to be no relation between the one aided and the ones drawn upon.

Many young men come to the university with rather vague thoughts of their life's work, not crystalized beyond the wish to study science, engineering, commerce, sociology, medicine, economics, or one of the other great divisions. In many instances their ideas are somewhat hazy as to the full meaning of these terms.

A distinguished chemist of my acquaintance told me that he came to the University of Wisconsin with a determination to specialize in psychology, which he then thought was to be his profession, but was diverted to the field of chemistry.

Entering University Without Decision

No young man should feel that it is to his discredit in any way if he comes to the university without definite future plans, for many have had a very limited view before that time.

The university presents, as does no other environment, the opportunity to survey the "activities of the world". It is the wise student who will not let this opportunity go by without using it to aid him in finding his proper place.

Except among those who know by experience, the engineering courses are generally believed to be based on narrow specialization, and I therefore wish to note something of their advantages for the purpose of a general education.

In the College of Engineering of the University of Wisconsin there are five courses, chemical, civil, electrical, mechanical, and mining engineering,—each a recognized standard broad division. By means of selection from these courses, and from subjects given in other colleges of the university, a student may specialize, if he so desires, in any of the very large number of engineering professions.

Why Study Engineering

An engineering course offers an excellent opportunity for the somewhat intangible thing known as a general or liberal education, which may possibly be defined as the training which fits a man to take his place in the affairs of the world provided he has the personal qualifications along with the training. Without these personal qualifications no kind of preliminary training will be of effect on his progress. The engineering courses require for admission a broad general training in other than purely technical engineering subjects,—such as history, economics, language, and others. These, or similar invaluable subjects, may be continued through the engineering course by making proper use of the free elective time.

I wish, however, to lay particular stress on many of the subjects in the regular engineering curriculum for their general training value although they are rarely thought of in this light.

Other professions point with pride to the human lives which rest on their decisions and correct practice, but I believe the responsibility of the engineer in this regard is many times greater than that of all other professions. The integrity of the bridge, railway, high tension line,

(Concluded on page 152.)

ALTERNATING CURRENT RECTIFICATION FOR ELECTRIC RAILWAYS*

By Parry H. Moon,
Senior Electrical.

It is universally recognized that direct current is superior to alternating current for traction work. The characteristics of the series-wound d. c. motor are ideal for this class of service, surpassing both single and polyphase motor, and causing direct current to be used almost exclusively in street railways, interurban systems, and electrified steam roads. The generation and transmission of large quantities of direct current for a road of any size, however, would not be feasible; so virtually all of the current is now generated in the mammoth alternators of great central stations, and is transmitted as high voltage alternating current which can be stepped down in the various railway substations. The problem remains of converting this alternating current to the direct current needed for car operation.

There are three general appliances for effecting this change: motor generator sets, rotary converters, and rectifiers. Both motor generators and rotaries are used; but since they are expensive machines and require expert attention, it is obvious that the use of some simple form of rectifier would be of marked advantage. The types of rectifiers which we have at the present time are (1) Mechanical, (2) Electrolytic, (3) Thermionic, (4) Mercury arc.

Of these, none have been made in this country in large enough sizes to be useful for railway work; and, moreover, none except the last seems to hold any promise for this class of service. The mercury arc rectifier, however, has recently been developed abroad so that large sizes can be constructed; and because of its high efficiency and its simplicity, it should prove of importance to the railroads of the United States.

The glass bulb form of mercury arc rectifier is familiar to nearly everyone who has used storage batteries or has otherwise has need to change small amounts of a. c. to d. c. It works on the principal that an arc in mercury vapor between a metal electrode and a pool of mercury will only conduct electricity in one direction — i.e., from the metal anode to the mercury. A schematic diagram of connections is given in Fig 1. In this arrangement, the secondary winding of the transformer is tapped at the mid-point which will always constitute the negative pole of the load. As the alternating current reverses in sign, the arc will be extinguished at one anode and will be started at the same direction and can be smoothed out by means of inductance in the leads. To start the converter it is first necessary to tip the bulb until the mercury bridges the gap to an auxiliary electrode (not shown). The bulb is then allowed to assume its upright position, starting an arc which vaporizes some of the mercury and allows the main arc to form. Rectifiers of this type are limited in size by the permissible diameter of the platinum lead-in wires, and have not been constructed for more than one hundred amperes.

*A Tau Beta Pi Topic.

During the war, Brown, Boveri and Co. of Baden, Switzerland attacked the problem of making the mercury arc rectifier in larger sizes. They were confronted by serious manufacturing difficulties such as the necessity of constructing large gas-tight containers, the troubles due to terminal bushings, and the means for preventing internal short-circuits. The company has now developed a line of steel-tank converters, however, which is entirely satisfactory. The following sizes are being manufactured:

Table I.

Type	Amps.	Voltage
G 3-16	300	800
G 4-6	600	800
G 5-6	900	800
HG 3-6	300	1200

There seems to be no reason why the machines cannot be built in much larger sizes and higher voltages. Slight modification would make the 1200 volt size suitable for 2400 volts.[1] Over 100,000 K.W. of units are already in operation in Europe.

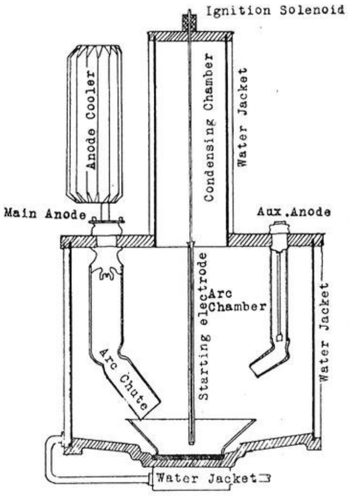


FIG. 2

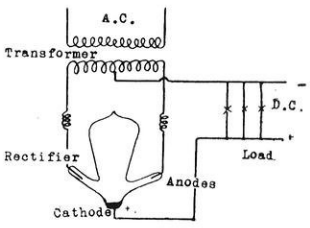


FIG 1

Fig. 2 gives some idea of the construction.[2] It will be noted that the rectifier consists of a sheet metal tank or arc chamber provided with cylindrical extension on top and a dish of mercury in the bottom. All joints are autogenous welded. The anodes are brought in from the top through special mercury-sealed bushings. Six anodes in conjunction with a six phase transformer is common practice. In order to direct the arcs and keep them from jumping to the metal case or the other anodes, arc chutes of insulating material surround each anode and extend nearly to the cathode. The mercury vapor rises into the upper chamber, is condensed, and drops back into the

(Concluded on page 160.)

ELLWOOD TRACTOR DEVELOPED BY WISCONSIN MAN

By Henry A. Burd,

General Manager, Ellwood Tractor Company.

The University of Wisconsin occupies a unique position in the development of the farm tractor. As long ago as 1898, C. W. Hart and C. H. Parr, students in the College of Engineering, built a gasoline engine as their thesis. From this was developed the first farm tractor to be commercially exploited. There has just now been placed on the market a tractor designed by Charles D. Ellwood which unbiased observers have called "the tractor of the future." In its development the University of Wisconsin has had a not inconsiderable part.

It was in 1898, when Hart and Parr were working on their engine, that Mr. Ellwood entered the old Wisconsin Academy. He came to Madison from a farm home and from three years of country school teaching, his desire for education having been rekindled by a young preacher who illuminated the possibility of his working his way. By working at all odd hours he was able to make his way through to graduation. From his sophomore year, his summers were spent in "experting" farm machinery for the McCormick Harvester Company. This method of spending the summer vacations was continued through the five years, following his graduation from the academy. During these years he graduated from the Milwaukee Normal School and taught three years in Wisconsin high schools.

THE ELLWOOD TRACTOR, A WISCONSIN PRODUCT

Like the Harley-Davidson Motorcycle, the Ellwood tractor was first designed while its originator was studying engineering at our college.

It often happens that one's avocation, by an absorption of interest and attention, becomes his vocation. Such was Mr. Ellwood's situation when, in 1907, he went to Canada as salesman of farm machinery. There, he saw the first gasoline tractors, crude and huge, turning over the virgin prairies. But Mr. Ellwood looked at them from the point of view gained by his early life on the 160-acre Wisconsin farm. He visualized the time when the tractor should be the universal power plant of the average farm, but to reach this ideal he knew that great changes must be made in the tractor to adapt it to the requirements of the small and medium sized farm. As his interest became more intense, his vision of the general purpose tractor, at first quite vague and hazy, began to take more definite shape in a mental picture of his own tractor. It was then that he left a good position with more than the ordinary prospects, to take up work at less salary with the Hart-Parr Company. He did this with the avowed intention of learning all that he could possibly learn from "experting" and selling tractors, with the idea that the information so gained would serve him later in building his own tractor. For seven years he was in Canada and our own west and northwest, selling and developing tractors, studying the farmer's needs, and noting opportunities in the tractor field. One day he announced to his associates that he was resigning in order to devote his whole time and energy to the development of a tractor about which he had been thinking for several years. He was laughed at as a fool for leaving a "sure thing" to undertake the very hazardous task of developing a new tractor, but he did not swerve from his purpose.

In the fall of 1914, Charles D. Ellwood again enrolled in the University of Wisconsin, this time as a student in the College of Engineering. For four years, his selection of courses was determined by the one object in mind: the building of a tractor. To supply technical engineering training, he took courses in Mechanical and Commercial Mechanical Engineering. He knew farm machiney from the farmer's point of view, but three courses in Agricultural Engineeering gave him valuable insight into the problems of the designer and manufacturer of farm equipment.

There is much campus talk of "extra-curricular" activities. From his first year, Mr. Ellwood's "extras" were merely other forms of tractor work. He found his recreation in the variety of forms which his work took; study, drafting, pattern making, machine work, organization, etc. Not the least interesting of these was the designing of the tractor itself. In a small room on the top floor of the Engineering Building, an unused elevator shaft, on borrowed tables were designed and redesigned the units of the tractor. Before long students and instructors had become so much interested in the new project that some were devoting their extra hours to work on the tractor.

Mr. Ellwood was not ignorant of the fact that an organization would be necessary to build and market the tractor when it was ready for production. He began very early to interest business men in a small way financially and thus formed the nucleus of an organization which has developed slowly and consistently as the tractor itself has been perfected.

AN ALL-AROUND FARM MACHINE

By the spring of 1919, after a small sized model had been experimented with, the first full sized tractor was completed. It was tested on the University Farm, April 12, 1919. Since then ten different models have been successively built and tested, each one embodying the experience gained on all its predecessors. The total cumulative result is the tractor as it now stands, a machine which has given entirely satisfactory service in the hands of farmers for a year and is now to go into quantity production.

It has been intimated that twenty years ago in Canada Mr. Ellwood began thinking and working in the direction of a tractor which would adequately meet the needs of the farmer of 80, 120, or 160 acres. During all those years, he has hewn to the line with surprising consistency. With the dogged determination of the successful engineer, he has gathered his data, assembled his materials, and then worked and reworked them to bring the most satisfactory results. Always from the start, he has been guided by certain fundamental requirements of the tractor, if it was to be the generally accepted success which he planned. Some of these requirements may be briefly stated.

As an initial minimum requirement, this tractor must do all the different farm operations that tractors already on the market can do.

In addition, it must do all other field work, such as planting, cultivating, mowing, harvesting, spreading manure, etc.

Every operation must be done with one man handling both tractor and implement.

Consequently the tractor and any implement must form a compact, wieldy unit.

The change from one implement to another must be made easily and quickly, and the necessary hitches must be inexpensive.

This tractor must work faster and better than horses and it must be able to a very large extent to utilize the standard implements already on the farm.

It must be built of the best materials and designed to give a long life of hard service.

Finally it must be simple, accessible, and easily handled.

Long experience on the farm, not only by Mr. Elwood himself, but by those associated with him, was the prime factor in dictating these requirements for the successful tractor. In must motorize the farm; it must be a universal power plant capable of quick and easy adaptation by one man to any and all farm operations. The Ellwood Tractor, according to those who have followed it, more nearly meets these requirements than any other machine on the market.

Fourteen years is a long time to spend in planning, studying, working toward a single objective. It is a much longer time when the study and the work involve tremendous sacrifices and when the only immediate reward is the satisfaction that comes from good work well done. Yet this in some measure is the history of every worthwhile achievement, of every major engineering development. And in nearly every case the goal is worthy of the effort.

THE BRAKES ON AMERICAN AND EUROPEAN MOTOR CARS

(Continued from page 142.)

some of the kinetic energy of the moving car to help apply the brakes.

A second and perhaps more important object is found in applying the railroad principle that the maximum retarding effect is obtained when the wheels are just short of locking.

The Hallot servo-brake is, briefly, a means of utilizing the centrifugal force of loaded shoes, revolving with the propeller shaft or wheel, to increase the braking action. When, under the action of the servo-brake, the rear wheels tend to slow down and lock, the centrifugal shoes let go, and the braking effect is thereby kept just short of locking the wheels, a condition very hard to maintain by ordinary brake mechanism.

Servo brakes can be used independently or in connection with two- or four-wheel brakes, but four-wheel brakes with a servo-brake attachment represents the best development to date.

THE 1922 ELECTRICAL SHOW

By E. D. BADER,
Senior Electrical.

Ye Olde Electrical Laboratory got the surprise of its life, when nearly 3000 people flocked in to see the Electricals "do their stuff" on April 20, 21, and 22. The motors are still humming with joy at the unwonted popularity they enjoyed during those three memorable days. This was the first electrical show ever held in Madison, but visitors were unanimous in proclaiming that it could never be beaten. Take heed, Class of '25, your turn comes next, and it is up to you, at least, to uphold the tradition established by the Class of '22. Beat it if you can.

Thrills and Fun Galore

The electrical laboratories were crowded from top to bottom with exhibits. Amusing and spectacular stunts were mingled with historical and technical ones, so that not a dull spot remained in the entire building. Everyone, from the grammar school boy to the old-timer in the electrical game, found enough to keep him interested and amused for more hours than one evening afforded; and many came back for a second look.

An orchestra, recruited entirely from among the electricals, played electrifying music, at frequent intervals. The lights danced, not to the tune of the music, but to the tune of the changing phase relations in two generators, and the hum of the machinery formed a low undertone to the incessant babble of voices that rose to a maximum whenever the audience found some new wonder to exclaim upon.

Corns and bunions were trampled on in the mob that gathered about the booth of "electrical mysteries," where Heinz and company sought to bewilder the people in true side-show manner. A couple of powerful electro-magnets, hidden under the table enabled them to fry eggs on ice, light detached lamps in fish bowls, float aluminum rings in the air, and do other things that were amusing even to the initiated, and absolutely mystifying to those not acquainted with the phenomena of the magnetic field.

The little shavers found the land of their dreams in "Dinty" Mohr's railway exhibit, where a little train ran around a track with stations, and switches, and tunnels, and everything, and many of them learned a fundamental principal of railroading when they derailed the train by improper switching, much to Dinty's wrath and their own fright.

Many Radio Features Exhibited

Bill Gluesing also had an enthusiastic following of coming electricals in the Amateur Radio Room, where he entertained them with his "line", and with a display of what might be called primitive radio receiving sets. A set made up mostly of kitchen utensils won the prize for simplicity and ingenuity.

A mechanical dog that could be started and stopped by a whistle, and Germond's radio controlled cart were big drawing cards for the radio exhibits that took up a large part of the second floor, although the display of receivers, sending sets, loud speakers, field signal outfits, and vacuum tubes received a great deal of attention from the radio fans.

High Tension Shocks

Schroeder succeeded in putting a real kick into the proceedings with the help of a 4,000,000 volt Tesla coil from the physics department, and did many shocking things, to say the least. A highly charged wire cage used in demonstrating the principles of a static field, afforded many thrills to the operators as well as the spectators, and some unusual high tension transmission phenomena were demonstrated by Parry Moon on a quarter-wave length line. The line was the equivalent of a transmission line 765 miles long, and attracted a great deal of attention from the visiting technical men.

Souvenirs for Visitors

Emblematical copper fobs were stamped, nickle-plated, strung on bits of bright red ribbon, and handed to the spectators as they passed the booth of Andree and his assistants. The work was well done, and the ornaments made effective badges and mementos of the Show.

An Education in Technical Features

In addition to the exhibits designed for amusement, a large number of technical displays formed a stabilizing basis for the show, and the men in charge deserve special mention for the talent and energy displayed in presenting these subjects in a way that could be appreciated by the average person, but the features were so numerous and so uniformly good that nothing short of a book would suffice to detail them all.

Class of '22 Establishes Precedent

To stage an electrical show in the laboratories had long been a dream of the Electrical Engineers, but it remained for the Class of '22 to make the dream a reality, and in doing so, they have established a precedent that will stand as a brilliant mark for future classes to aim at. The success of their first undertaking has demonstrated its feasibility, and there is now no reason why other departments of the Engineering College should not join hands with the Electricals, in a plan to hold an Engineering Exposition every four years, thereby focusing public attention, at intervals, upon the practical accomplishments of the College, and upon its members as individuals.

Roswell H. Herrick, '22, President of the Student Branch of The American Institute of Electrical Engineers, initiated the movement last fall by appointing Ernst A. Guillemin, '22, general chairman of the Show Committee. Success of the show is due to Guillemin's untiring efforts in organizing and coordinating the efforts of the various groups. He was assisted in this work by Hugo A. Rusch, '23, treasurer of the general committee, Earl D. Bader, '22, secretary, and Raymond L. Paulus, property manager. The high quality and effectiveness of the exhibits, however, was due to the many other engineers, who liberally donated their time and energy to the success of the project.

BRIDGING THE OHIO

As Told by an Alumnus.

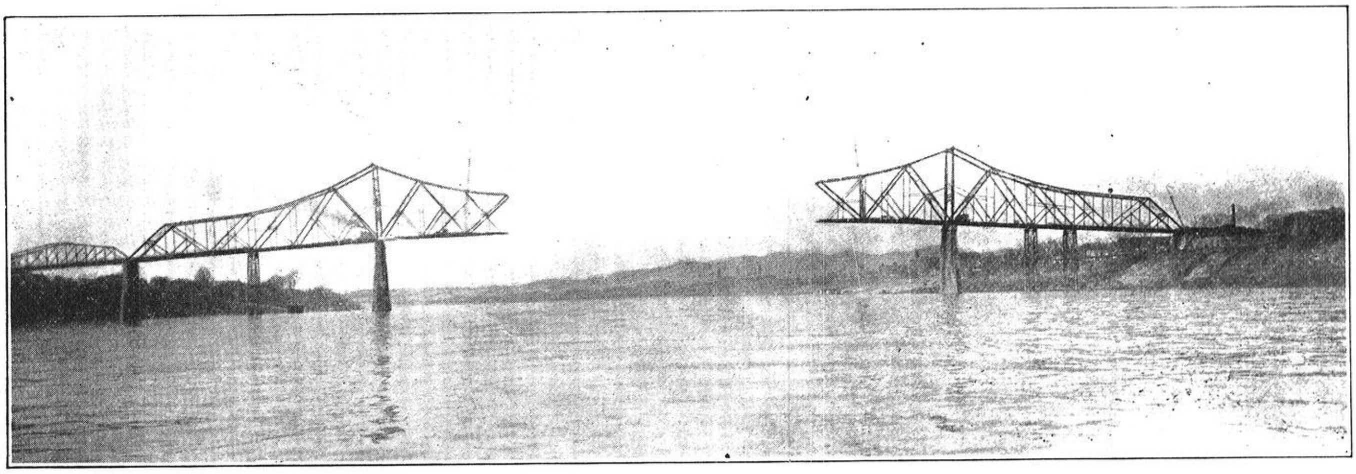
So accurately operated were the three-legged telescopes, the big drawing boards, and other engineering equipment equally puzzling to the popular mind, that when finally the huge link connecting the two halves of the bridge shown in the picture below was put into position, the bolts were slipped into their proper holes without so much as a hammer tap!

Wisconsin's representative in the project was J. P. Bendt, c '12, who acted as resident engineer of the corporation for which the bridge was built. The structure splits a 275-miles bridgeless gap across the Ohio River, being 142 miles up the river from Cincinnati and connecting the towns of Ironton, Ohio, and Russell, Kentucky. The Wisconsin Bridge and Iron Company of North Milwaukee were the builders. The cost was $700,000.

"One interesting feature was the order of erection", writes Mr. Bendt. "The raising crew would erect a panel on one side of the river with the bolting crew following. Then they would transfer to the other side of the river to erect another panel, the riveting crew 'driving up' the panel last erected. This alternating back and forth across the river worked nicely, for the same crew profited by its experience in erecting similar panels, saving sometimes two days in the erection of the second panel."

"The steel was unloaded by derricks from the railroad cars and placed in storage yards where it was handled directly to the construction cars which carried it to the working front. The heaviest piece of steel handled was the bottom chord for the first panel outside of the piers. It weighed 13½ tons and was 58 feet long. The most difficult piece to handle was the top chord of the same panel, it weighing 11 tons. The drift of the boom was 97½ feet and the center of the top chord above the floor was 93 feet. The boom stood vertically when this was placed, for the mast was but 7 feet from the truss and the chord was 33 inches wide. The suspended span weighs 420 tons, and was erected by using cable slings to hold the bottom chord of each panel until the panel could be bolted and riveted to carry itself.

One raising crew of 6 men, one rivetting crew of one heater, 2 riveters, two helpers, and a labor crew of five men, one extra engineer, a timekeeper, and a foreman comprised the erecting force. A resident engineer and assistant completed the crew of 26 of the construction company. Work was begun July 19, 1921, and completed April 21, 1922. The spans, beginning at the Russell side, are respectively 201, 350, 725, and 350 feet in length. About 2500 tons of steel and 6200 cubic yards of concrete were required in the construction. The bridge is designed for highway and interurban traffic.



THE RUSSELL-IR ONTON BRIDGE

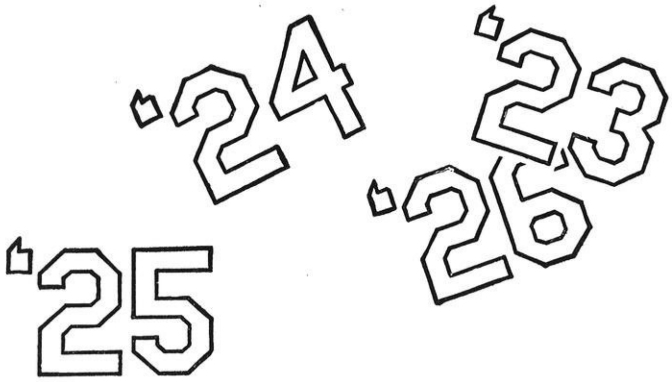
Fitting the pins into their proper holes when the last huge span finally connected the two parts of the bridge required not even a hammer tap, so accurate was the construction work.

Why High Schoolers Aren't Bridge Builders

"One item of human interest," continues Mr. Bendt, "is about a lad who had just finished high school last June and who decided that he wanted to work instead of going to college as his father had suggested. He pleaded several times to be put on, and was told that there was no work for him. Finally he said, 'Can I work for you for nothing? I've got to prove to Dad that I have a job!'

"He worked about five days and on the sixth did not show up. The following Monday he came in all dressed up. 'Guess I've got to go to school to learn how that engineer (Mr. N. W. Chapman, resident engineer for the Wisconsin Bridge and Iron Company) can find a stake half a mile across the river with only an instrument, while I, who put it in myself the first day, have hunted the other four. Guess I'll go to college.'"

"The student who is ranked in the lower half of his class must assume the burden of proof and show distinctive qualities of leadership or special ability to offset his scholastic rating." (W. E. Wickenden, A. T. & T. Co.)



Which will next year's captain wear?

IT DOESN'T need much wisdom to predict that next year's nine will be captained by a '23 man or maybe a '24 man.

This is no affront to underclassmen. Years of steady plugging must go before you can handle the man-sized responsibility of running a team.

That this is just, seniors will be the first to assert. They have seen how well it works for team and college. Then let the seniors keep this point of view, for soon they will find how closely the principle applies to themselves in the business world.

Captains of industry are not made overnight. Don't expect to step into a managership right away. Before you can lead, you've got to serve in the ranks awhile.

This is best for your organization and best for you. The time and energy you put in working up from the bottom, taking the bitter with the sweet, getting the upperhand over your job, will stand you in good stead when you have won through to executive position.

When you have learned how to handle detail work, you can begin intelligently to direct other men to do it, and thus free yourself for creative planning.

You who intend to be captains, have patience. Your year will come and so will your chance.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

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Number 18 of a series

THE SURVEYING DEPARTMENT'S COLLECTION OF OLD INSTRUMENTS

By H. H. WHEATON
Senior Civil.

A strange old brass-finished engineer's-level lies in the cabinet that stands just outside of Professor Ray Owen's office on the first floor of the Engineering Building. It is worth more than a passing glance for it is the instrument that was used by William M. Hough when he was county surveyor for Dane County between 1853 and 1858. The engineers of the University took great pride in the appointment of Charles R. Van Hise, a graduate of this college, to the presidency of the University in 1904; but few of us knew that almost exactly fifty years before, another engineer, William M. Hough, had been offered the position. He had come to Madison, in 1853, from Peekskill, N. Y., where he had been owner and principal of the Peekskill Boys' School. Among his pupils were Chauncey Depew and the boy who became General Hancock.

This ancient level is only one of a collection of surveying instruments and relics that fills the cabinet. There is a "scribe" which looks like a can-opener but was used for another purpose. With it the government surveyors of fifty years ago carved strang hieroglyphics on trees at section corners. During the interval between that time and this, many things happened to the trees. Sometimes the bark grew over the marks, covering them completely. The modern surveyor is not discouraged by the disappearance of his landmark, however; he peels the tree and uncovers the long lost scribings. One of the interesting exhibits is a section of bark that grew over such scribings and now carries their imprint in the "negatve."

Our illustrious fellow engineer, George Washington, was obliged to drag a chain over the many miles of wilderness that he surveyed. The "Chain" was used to measure distances and derived its name from the fact that it was made up into links for convenience in rolling it up. Incidentally, the links served as units of measure. The name "chain" has adhered to the 100-ft. steel tape that is commonly used today by freshmen and engineers, but the original, or "Gunter's" chain was 66 feet long. Such a chain is just four rods long, and eighty chains make a mile. Old measurements are sometimes given thus: Two miles, twenty-seven chains, and fourteen links. The "link" is 0.66-ft. long, on hundred of them making a chain. Several of the chains are on exhibition.

George Washington's successors were on the outlook for the easier way and developed a painless method of measuring distances. When they had a job of measuring to do and there was a road available, they attached an "odometer" to the wheel of a vehicle, climbed into the back seat where they could look around and admire the scenery, stoked the old corncob, gave the driver the high-ball, and rolled off. Even and anon someone climbed down and took a reading of the odometer. This odometer was the grand-daddy of the speedometer that is used on the motor cars of today. (Oh, Boy! If Professor Owen would only let us freshmen do our chaining in a motor bus!) It gave the number of revolutions of the wheel on the journey and the surveyor could easily compute distances corresponding to its readings. Certainly there is an odometer in the collection; that's it there on your port bow.

All good engineers are familiar with the slide rule, but not so many are acquainted with slide-rule's cousin, "planimeter". The planimeter is just as handy a device when it comes to measuring irregular areas as the slide-rule is for computations. No matter how odd the shape and outline of a figure, it must yield the secret of its area to this magical instrument. It is a right-up-to-the-minute instrument, as is the pantograph which reposes in one corner of the cabinet, and the alidade which stands on a shelf nearby.

Although it contains many articles besides those mentioned here, the collection is in its infancy. It is hoped that our fellow engineers will add to it whenever they find material of interest.

THE RAYMOND COMPOSITE PILE

(Continued from page 141.)

replaced with a single long bar having a special screw welded to its lower end. Just before the concrete is placed in the driven pile shell this long rod is screwed into a small steel socket which has previously been set in the wooden pile head and held in place with a steel pin. This arrangement fastens the concrete and wooden piles tightly together, and bending and tension tests on joints of this type have proved that it is somewhat stronger than the joint with the four reinforcing bars.

Although the idea of a combination wood and concrete pile is not a particularly new one, since such piles are known to have been used as early as 1905, the Raymond type of composite pile is new, since it has been in use at this time but about six years. From time to time minor defects have appeared both in the construction of the pile and in the method of installing it, but as has been pointed out, changes and improvements have been made to overcome these difficulties. The future will probably bring more changes and improvements but the Raymond Composite pile has undoubtedly long since passed the experimental stage, and is now prepared to take its place among the standard types of foundation construction

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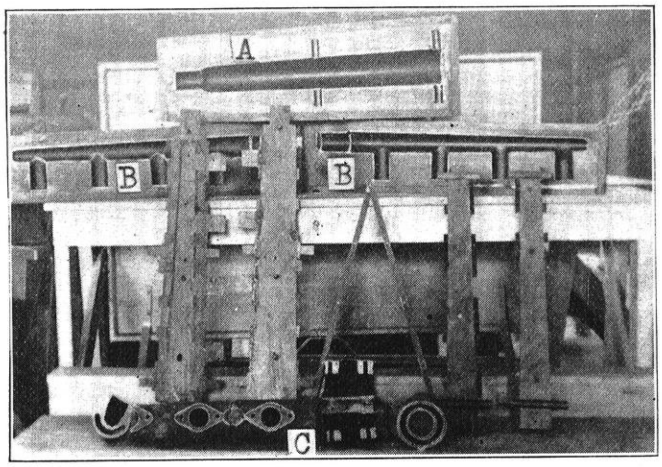
Sixty per cent of the presidents, operating vice-presidents, and general managers of the railroads of this country began their railroad careers in the engineering department.

STUDENTS MAKE EXPENSIVE PATTERNS

$1.75 per hour is an attractive wage for even the best of pattern makers, but six supposedly impractical, theory-stuffed, classroom senior mechanicals actually did earn that wage this semester in the course in advanced pattern making, a prescribed subject. Their success in the work causes one to wonder if our college really is teaching too many practical things and not enough theory, as some engineering educators might suggest.

Lake Mendota water freezing in the water jacket of the exhaust manifold on the Cardinal, the university life boat, created the job for the above mentioned pattern makers. "Cap" Isabel had found upon ordering another manifold from the builder of the boat that all patterns for that model had been destroyed, and that the cost of making new patterns, core-boxes, and of molding and machining would be $215. Not wishing to bankrupt the university, Cap hunted elsewhere, and subsequently learned from Prof. Dabney how, if made in his department, the new manifold would be a source of revenue and not an enormous expenses. How? Well, cast iron is



Senior M. E.s in turning out the above patterns for an exhaust manifold saved the University $175.

cheap, and student labor still pays three dollars per credit for being allowed to work.

So complicated was the job that it is believed to be the most difficult problem in pattern making ever attempted in the university shops. To illustrate: when asked what he was doing one of the M. E's replied that he was "turning the form which shaped the core-box which shaped the core which formed the water jacket." Both cores were round and tapered, and were made in plaster paris core-boxes formed by imbedding wooden forms A and B in the plaster mass and allowing to set. Since these pieces A and B were easily and quickly turned on lathes, this process of making the core-boxes was much easier and more accurate than if they were gouged from blocks of wood. Dimensions were taken directly from the casting, which was purposely sawed in several parts, as shown at C, to faciltate the taking of measurements.

Machine time, cost of materials, molding, and installation charges were $40, leaving $175 assignable to the 100 hours work by the pattern makers. The work was under the supervision of Martin Payton, instructor in pattern making. Mr. F. X. Ritger, university purchasing agent, conceived the plan of assigning the work to the shop department.

THE ENGINEERS' DANCE

By Earl Caldwell,
Sophomore Mechanical.

There were dances and dances in the past season, but it is safe to suppose that no Slip-sticker enjoyed any of them this year more than he did the Engineers' Dance.

This annual event, sponsored by Polygon, was held in the Woman's Building, on Friday, April 28. Those who were in charge deserve much praise for the judgment and taste which they displayed.

It has become a sort of custom that dances, to be successful, must be wierd, wild, and clamorous; that they feature some more or less clever "specialist"; in short, that they must eclipse in some way, all of their predecessors. The Slipstick Prom did that very thing but in a far different and altogether pleasing way. It was a splendid evening, because it was a dance, and not a noisy orgy.

The lights were at the same intensity all evening, hence there was no case of being lost in the dark one second, and of being blinded by a spotlight in the next second. Nor was there any confetti or serpentine paper to make things tawdry. The squealing clarinets and laughing trombones were notably and gloriously absent, and so were the "specialties."

Because it lacked all of the usual embellishments it was a good dance. The essence of any dance is the music and dignity of the affair. It can be said that the music was good,—even artistic. It was real music and melody and not "hodge-poge"—truly a miracle. May Jess Cohen and his men play like that all the rest of their lives.

The good music and the lack of tawdriness gave to the affair a dignity which came to most of those present as a welcome relief in this era of blatancy and jazz..

Professors and Mrs. D. W. Mead, R. S. Owen, and A. V. Millar acted as chaperones.

ENGINEERING FOR GENERAL EDUCATION

Continued from page (145.)

There is required in the technical engineering subjects a rather special kind of reasoning; the solution of problems is based oftentimes on somewhat conflicting data, and yet a result both safe and economical must be obtained. The training in accuracy of execution due to the drawing, design, laboratory practice, and allied studies is of value in any business or professional enterprise. It is becoming recognized that an engineering training is of great value in the selection of men to manage business affairs.

On account of the wide application of engineering developments it would appear that some fundamental knowledge of engineering principles might well form a part of what is known as a liberal education.

THE SUMMER SURVEYING CAMP

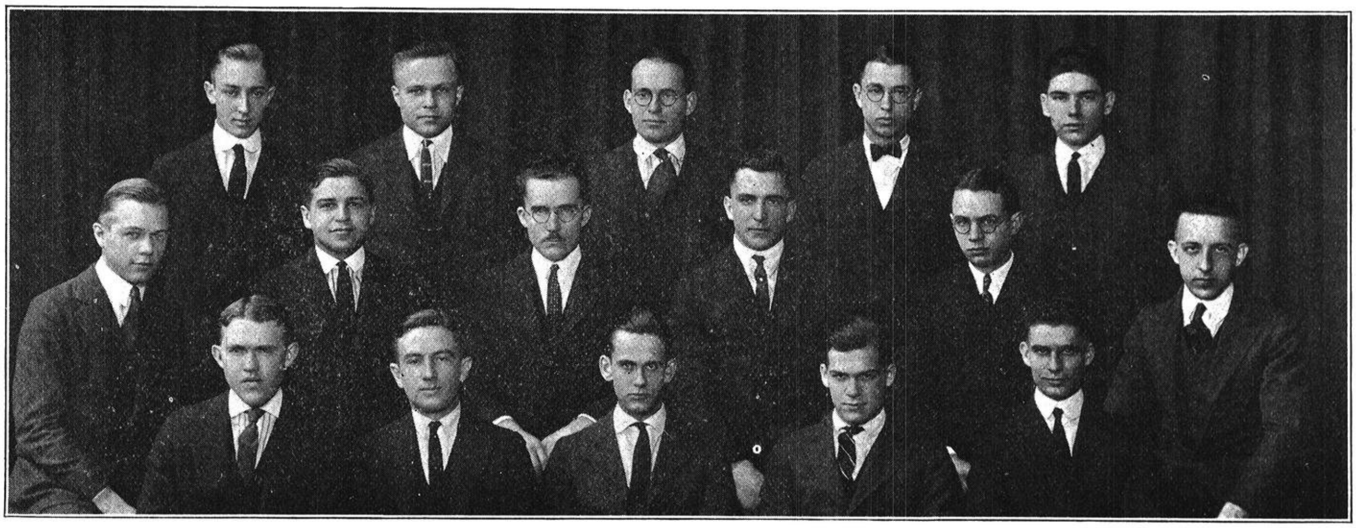
The seventy-six men who are to go to Devil's Lake for summer surveying this year will find life more interesting than it has been in the past. Numerous changes have been made in the camp schedule.

THE TURNOUT PROBLEM

The work will be so arranged that either the railway course or the regular surveying course may be taken alone. This is for the convenience of men who have but one course to complete, or who, for some reason do not wish to take more than one. It will also be possible for men to take from one to four weeks of extra work, for which credit will be given at the rate of one credit a week This extra work will apply on elective credit.

Two new boats have been bought for camp use, in addition to a new outboard motor. The department has had an Evinrude motor in the past, and with Joe Romeis added as mechanical engineer of the camp, it is hoped that at least one boat will always be ready for use. There is to be a floor for the dining tent and a new roof for the camp barn. Indications point to an unusually good student orchestra this year.

EDITORIALS



THE STAFF

Pfeifer Bohman Drewry *(Editor)* Streck Thiel
Rusch Wupper Bader Buese *(Manager)* Sogard Kolb
Chase Phillips Blanch Smart Hirshberg

AN INVITATION TO HIGH SCHOOL SENIORS This issue of THE WISCONSIN ENGINEER is being sent to the high schools of the state as a reminder to you men who are about ready to begin laying plans for your after-high-school career, that you have not yet exhausted the educational possibilities which your State offers you. We suggest that you give serious consideration to the matter of obtaining a college training. If you decide to do so we can assure you that you will find no better facilities anywhere than are offered right here in Wisconsin, in the state university at Madison.

We mention this to you, not with the desire to swell the already large attendance at the university, but with a desire to attract those men who are able and willing to carry on the honorable traditions of our university and particularly our College of Engineering. The weak and trifling creatures we do not want; the high grade man is always welcome, no matter how crowded our halls may be.

It is hoped that you will find the contents of this issue of interest. If you desire further information in regard to engineering, or this college, we will gladly answer your questions, as student to student, if you address your letter to the Editor of this magazine.

THE DEAN'S RECOVERY The recovery of Dean Turneaure from his long and severe illness is the cause of rejoicing among students, faculty, and alumni of this college. That the work of the college has gone forward so well during his absence is a tribute to his ability as an organizer as well as to the energy of Professors Millar, Maurer, and others of the faculty. Nevertheless, the school has missed its Dean and is happy in the thought that he will soon return.

"Every man owes some of his time to the upbuilding of the profession to which he belongs."

THE SIGNIFICANCE OF OUTSIDE ACTIVITIES The tides of favor flow and ebb. A few short years ago the faculty members of this college were urging the somewhat diffident and retiring engineering student to go into outside activities for the purpose of rounding out his training. Employers added their voices to the tocsin of the teachers and the tide was in flow. The student hearkened to the advice and plunged into various affairs. As was to be expected, individual students have displayed poor judgment in apportioning their time and effort between scholastic work and their "activities", and have gotten themselves into various and sundry jackpots. Now certain faculty voices are heard protesting against the activities. The tide begins to ebb.

Will the tide run out until the activities are left gasping for air and existence? It is to be hoped not, for they serve a useful purpose. Granting that scholastic work is the prime business of the student during his college residence,—and we do grant it—the fact remains that the outside activities give him the opportunity of displaying and developing four most desirable personal qualities: Courage, energy, talent, and unselfishness. No man can undertake and carry to success any of these

(Continued on page 156.)

ATHLETICS

H. A. Phillips

NELSON TROPHY RACE CLOSE

Featured by close competition in all branches of sport, the Nelson trophy race this year is proving an interesting competition between the Letters and Science and Commerce students, the Agrics, and the Engineers. With basketball, cross-country, swimming, indoor track, and gymnastics run off, other events are under way, and several are yet to be started.

In cross-country, the first event of the year, the Engineers took first, Commerce second, and Letters and Science third. Basketball was won by commerce and second place was taken by Letters and Science, while the athletic department seems to have no record of third and fourth. Indoor track was won by Letters and Science, with the Agrics second, Engineers third, and Commerce fourth. Gymnastics was won by the Engineers, with Agrics second and Commerce third.

Of these five events, the Engineers have taken first in two, cross-country and gymnastics, second in swimming, third in track, and probably third in basketball. Track and basketball count more than the other events, and a summary of the probable points gives the Letters and Science boys 84, Engineers 78, Commerce 69, and Agrics 63. This is not necessarily a correct rating, as several unknown positions have been assumed, in order to distribute all the points.

Baseball, outdoor track, crew, and soccer will be the deciding factors. The first three of these are major sports, and count high for points. In addition, there are tennis, handball, boxing, wrestling, and a number of other events to be heard from. It is simply up to the Engineers to step out and win that trophy!

KNOLLIN PLACES AT PENN

Captain Al Knollin, hurdler, and Dale Merrick, vaulter, represented the University at the Penn relays April 29, Knollin placing third in the 120-yard race, and Merrick ,who won the vault last year, tying for fourth. These men deserve considerable credit for placing in the events, since the track men have been out doors for less than a month.

The larger squad went to the Drake relays, at Des Moines, that day. Stolley, Wisconsin's other hurdler, took second in the 440-yard hurdles and Sundt placed second in the shot put.

FINKLE RECOVERS SLOWLY

George Finkle, '23, who broke his leg in the dual meet with Notre Dame, is recovering slowly, and will lose this semester's work at the University entirely. George has been on crutches a few times, but finds the going pretty hard, and spends most of his time in a wheel chair.

CREW STARTS LATE

Unfavorable weather in the form of a late spring has handicapped the crew considerably this year, though it finally managed to get on the water April 20. The boys are out regularly now, and look like a bunch of real oarsmen. Coach Harry "Dad" Vail is one of the best in the country, and Wisconsin's crew this year ought to be a good one.

The University of Manitoba crew is to be entertained here May 27, in the first race of the year for the Badgers. This is also Venetian night, and the date of the State Interscholastic track meet. Negotiations are under way to bring the strong University of Washington crew here when they are on their way east, and if time trials warrant it, it is possible that the Badgers too will be seen at Poughkeepsie. Coach Vail is also considering an invitation to row the Duluth Boat Club, which defeated Wisconsin last year by only a length and a half, and later won the National championship at the Buffalo regatta.

The men who sit in the shell now are: Newcomb, stroke; Johnson, seven; Crozier, six; Schultz, five; Plettner, four; Turner, three; Puestow, two; Captain Toepfer, one. Okerstrom, recently declared eligible, and a member of last year's crew, may replace one of the men in the shell now, and Jones, a husky sophomore, also looks good.

EDITORIALS

(Continued from page 155.)

outside activities without being called upon to exhibit all four of these qualities. On the other hand, a man can slide through four years of required college work and walk off with a diploma at the end of it all, and not have a single one of the four qualities in his make-up. We believe the activities are worth while.

But while activities have their value, they should not be overvalued. The first business of the student is his study. If his required work does not consume all of his time and energy, then he may take on outside affairs until he has reached his limit. That limit varies with the individual; a man must learn his limit and stay within it. And first of all must come the real business of the student,—his required scholastic work.

BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

If you are 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. 3.

ALUMNI NOTES

E. D. BADER

ANOTHER WISCONSIN ENGINEER IN THE LIMELIGHT

Olaf Laurgaard, c '03, CE '14, is being boomed as a candidate for Second Vice-President of The American Association of Engineers. He is the presiding officer of the Oregon Chapter, and has the support of many of the strongest chapters in the West. Laurgaard's record as printed in the bulletin sent out by the Oregon Chapter is an enviable one, even for a Wisconsin Engineer, and we are proud to know that he is one of our alumni. His record indicates, among other things, that he is married, and has two children, a son nine years of age and a daughter eleven; that he is a member of the Portland Chamber of Commerce, Portland City Club and other social and fraternal clubs and societies; that he is the President of the State Board of Engineering Examiners, which has in charge the registration of engineers, and that he is City Engineer of the City of Portland. During 1917 and 1918 he was a member of the Oregon State Legislature from Multnomah County, and acted as Chairman of the Committee on Irrigation, was a member of the Committee on Roads and Highways, and wrote the New Irrigation District Code, the State Highway Code, Sanitary District Code, and other development measures which were enacted into laws at that time.

Ray Behrens, c '19, is resident construction engineer with the Wisconsin Highway Commission on 19½ miles of concrete paving on Highway 15 in Washington County. His address is Allentown, Wisconsin.

C. C. Boardman, m '10, is assistant general manager of the Western United Gas and Electric Co., Aurora, Ill.

Bernard C. Brennan, c '05, city engineer of Kenosha, Wis., has resigned to enter the road-contracting business.

R. W. Cretney, ch '21, asks that his address be changed from 242 Spruce St., to 262 South Broadway St., Aurora, Ill.

Herbert Glaettli, c '19, spent a few days in Madison lately. Herb is with the Prairie Pipe Line Company at Independence, Kansas.

Scranton H. Gregg, c '21, is not with the Wisconsin Highway Commission as announced in the last issue of the ENGINEER. He has been, and still is, with the Wallace & Tiernan Company of Chicago, where he is engaged in sales engineering.

Louis R. Howson, c '08, C.E. '12, was made a member of the firm of Alvord and Burdick, consulting engineers of Chicago, on January 1. The firm will be Alvord, Burdick, and Howson.

R. B. Kile, e '15, has resigned his position with the Edison Commonwealth Company, (Brooklyn Office), and is now doing electrical engineering work with a Texas Company.

Charles A. Rau, e '17, has resigned his position with the Corn Products Refining Company, and has accepted the position of master mechanic with Jansen & Schaefer, Municipal Contractors, having their offices at Pekin, Illinois. This company has been doing considerable concrete highway work, laying as much as one mile of concrete road per week.

Aubrey H. Bond, c '17, is captain in the Engineer Corps, War Department, Washington, D. C.

"Nick" Isabella, c '14, assistant maintenance engineer with the Wisconsin Highway Commission, at Madison, writes on "The Wisconsin Idea as Applied to Detours" in the "Concrete Highway Magazine'' for April.

O. Laurgard, c '03, CE '14, has been nominated second vice-president of the American Association of Engineers.

A. H. Martin, e '09, is with the Wisconsin Highway Commission. He called at Madison recently.

Karl C. Miller, c '21, is with the Corrugated Bar Company at the Chicago office of the company.

L. F. Nelson, c '16, was in Madison recently. He is Designing Engineer for the Paul J. Keelman Company of Milwaukee. His visit to Madison was made in connection with the preparation of estimates for the new Madison Gas & Electric Company's addition.

AN UNUSUAL "BIRD''

By A. J. Goedgen, c '07, in the Alumni Magazine

Sixteen years ago, seven "07" Electricals formed a little club and called it the Direct Current Dynamo Club, or, mathematically, simply DCDC or "DC Squared." R. L. ("Dick") Loesch, L. F. ("Louie') Reinhard, C. W. ("Chuck") Green, E. P. ("Stroke") Hubbard, "Manager," Allen Hibbard, R. B. ("Marc") Anthony, and A. J. ("Al") Goedgen made up the membership.

Graduation came along and "Dick" Loesch started a round-robin letter among the seven members. This "robin" has flown over its nationwide circuit since the summer of 1907, and is still as active a bird as ever. Its route includes Milwaukee, Chicago, Montrose (Colorado), San Francisco, New York City, and Baltimore. It makes its circuit every six to eight weeks and has already traveled a million miles. It might be said "the first million miles are the hardest," as each year the "bird" is more deeply endeared to DC².

It has served to keep seven college chums in close touch as it seems only a round-robin letter could do. The contents of the big envelope are always highly informal and very interesting. It contains everything from one of "Louie" Reinhard's stories to a political discussion, or a report of some member's visit at Madison, or apicture of "the family."

College friendships are usually the best of our entire lives, so why not continue them systematically by means of "round-robins?"

Dwight Stiles, c '20, who has been assistant engineer in the testing laboratory of the Wisconsin Highway Commission since his graduation, has resigned, and accepted employment with the American Bureau of Inspection and Tests. His new address is 1741 Monadnock Block, Chicago. Dwight's training fits him admirably for his new duties.

R. E. Stoelting, c '09, city planning engineer for the city of Mliwaukee, has recently been appointed head of the Department of Public Works. **F. W. Ullius, Jr.**, c '11, Engineer of Shorewood, Wis., has been appointed to succeed him as city planning engineer.

Forrest E. Smith, m '21, has changed his address from 60 West Schiller, to 4426 Grand Boulevard, Chicago, Ill.

Erich G. Schroeder, c '14, is in business in Milwaukee as the Erich G. Schroeder Co., specializing in engineering and building service. The firm address is 405 Broadway.

A. R. Taylor, EE '14, is acting as budget engineer for Henry L. Doherty and Co., of New York. He called at Madison the eighth of April.

J. W. Watson, e '02, is in charge of the committee on gowns and decorations for the '02 class reunion which is to take place in June.

Harry R. Whomes, m '00, is production manager for the Dearborn Truck Company, at Chicago. **Myron M. Fowler**, e '01, is engineer for the General Electric Co. at Chicago. These two are now more or less dignified members of their profession, but back in the tail end of the 19th Century they were underclassmen taking math under Charlie Slichter. And it came to pass one day that Whomes sat behind Fowler in class and was moved to write with chalk upon the back that was placed before him so temptingly. Professor Slichter saw what was going on and spoke. "If you have anything to publish, Mr. Whomes," he said, "better use the Cardinal." Unabashed, Whomes answered, "This is better. The Cardinal hasn't such a big circulation."

R. T. Logeman, c '99, acted as business manager for the Chicago alumni club play, "On Wisconsin".

John M. Wood, m '17, writes that he is employed with the Stout Engineering Company of Detroit, makers of the first all-metal aeroplanes in this country. The first product of the company, a duralumin monoplane, successfully made its first flight April 26, near Detroit. Mr. Woods' work has consisted of the design of rolls for sheet metal structural members, and the layout and checking of jigs for wing spars, as well as having charge of the construction of the fuselage.

CAMPUS NOTES

J. W. SMART

Instructor, (to Senior Civil in the Dynamo Lab for the first time.) "Now in this experiment, you get the characteristic of this generator."

Same Civil (three minutes later, at the instrument room window): "I want an ammeter, a voltmeter, and the characteristic for machine No. 1056."

Steen (in E. E. 143a): "The reason the sixth harmonic is eliminated in an alternator with a 5-6 pitch is because it is not present."

Strock (to group at the radio booth, Electrical Show, listening to music from loud speaker): "Listen carefully, ladies and gentlemen. That music you hear is coming all the way from Schenectady, New York. . . . . "

Voice in loud speaker:

" . . . . WHA broadcasting, Department of Physics, University of Wisconsin."

"Did Polly Phase you?"

"No, but Anna Lyze to me."

Our idea of a soft snap is coupling up the beat notes on a wave train. But,—you must be careful to avoid interference.

If a RICHMAN got too SMART, and STROCK a STEIN with a KNOTT in the DOHRway, and if MAC CANN walk across a MAN'S FIELD, WU WOOD not be SHOKT and emBARRUSed?

HuRAHR for our side!

WATT'S it to you, anyhow?

We hope that GOETZ across to you.

It OTT to, at any rate.

Humbly submitted in the hope that it may assist the editor to make up the Campus Notes.

The Gold Dust Twins.

We thank the Gold Dust twins for the above dozen. Let's hear from them again next year.

The University was visited on April 21 and 22 by the California Commission on Agricultural Education. Dr. Alwood Mead, professor of Rural Institutions and Irrigation Practice at the University of California, chairman of the California Land Settlement Board, and a member of the commission, spoke to the junior and senior engineering students, April 21, on "A State Experiment in Land Settlement".

The success of the recent Electrical Show was due to the able chairmanship of Ernst Guillemin, assisted by H. L. Rusch, treasurer, E. D. Bader, secretary, and R. L. Paulus, property manager.

SICKNESS DE LUXE: Among the numerous tokens of regard which came to Dean Turneaure during his many weeks at the Methodist Hospital this spring, the radio receiving set, which was installed at his bedside, stands out with peculiar interest. It causes a revolution in our views of sickness. The invalid of the past,—a pathetic figure, cut off from the activities and pleasures of health—is metamorphosed into a luxurious individual who has his meals brought to him, and listens to concerts, sermons, and weather reports whilst comfortably ensconced between two sheets. It's a gay life—if you don't weaken.

One gift, which was prepared for Dean Turneaure, never reached him. A small crystal-detector set was made by Mr. Romare, the college mechanician. It is an unusually neat bit of work, mounted in a box about six inches square by four deep. It was just ready for delibery at the time the more powerful set was installed in the hospital.

Mr. Wise, of the electrical department, has recently blossomed forth with a new Jordan car. Yes, Mr. Wise and Mr. Jordan are prominent alumni of the University. Rumor has it that every time the car gets parked in the garage for the night, it gets its left hind wheel removed, said wheel reclining peacefully with the owner until the dawn approacheth.

UP-TO-DATE WAYS TO FOOL THE MODERN BABY

"----------This is station KXW --------Pittstroit WHO-O-O-O-O-E-E-E-E--------------Daily bed-time story — Gr-r-r — Gwe-e-e-e-e. Once upon a time there was a beautiful little girl who lived in — Blurp-ur- blup-blp. ------------

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Dean F. E. Turneaure is a member of the national committee on commercial engineering appointed by the U. S. commissioner of education to investigate business training of engineers and engineering training of business students.

Pi Tau Sigma, honorary mechanical engineering society, initiated the following, all juniors, into its organization, April 27: T. L. Ahern, A. F. Bowers, W. H. Carson, L. M. Johnson, R. W. Kahlenberg, D. A. McArthur, J. L. Peterson, R. H. Raube, John Slezak, and B. F. Wupper. Prof. Orth was made an honorary member.

Tau Beta Pi, honorary engineering society, announces the election of the following: E. G. Mansfield, e '23, H. L. Rusch, e '23, K. M. Watson, ch '23, M. C. Hansen, ch '23, R. E. Johnson, e '23, D. M. Harbaugh, m '23, D. H. Edwards, ch '23, E. B. Jewell, e '23, W. J. Tesch, ch '23, L. G. Adam, e '23, J. L. Peterson, m '23, C. F. Buchner, min '23, C. E. Wheeler, c '23.

A. S. C. E. BANQUET

An excellent banquet was enjoyed by the student chapter of A. S. C. E. at Wesley Hall on May 9. Faculty and local members were guests. Though this was the first annual banquet, it was a decided success.

During the progress of the Electrical Show, "Al" Klann was explaining the action of a transformer with the assistance of a model to a group of girls. "You see the changing magnetic field due to the primary induces a voltage in the secondary which causes a current to flow thus lighting this little lamp. Notice that there are no wires of any kind connecting the two coils.

Girl in group: "Do you mean to say there are no wires between the two?"

"No connection whatever."

Girl (after a moment's pause): "Nope, you can't kid me "

According to the E. E. department a squirrel cage motor is used to start a synchronous motor without hunting.

Twelve miners and an instructor recently spent about a week in Mayville inspecting mines. To quote from the "Mayville News", they spent their time "hiking to and from the Steel and Tube mines for practical experience."

Mr. Aagaard in S. & G. 1: "Now at this point the inlet valve opens, and it stays open until it closes."

"Ain't nature grand?"

It has been reported that a new boat is to be put on Lake Mendota to assist the Cardinal in its life-saving pursuits. The old launch will be used as an auxiliary life-saving launch, and as "Dad" Vail's coaching launch.

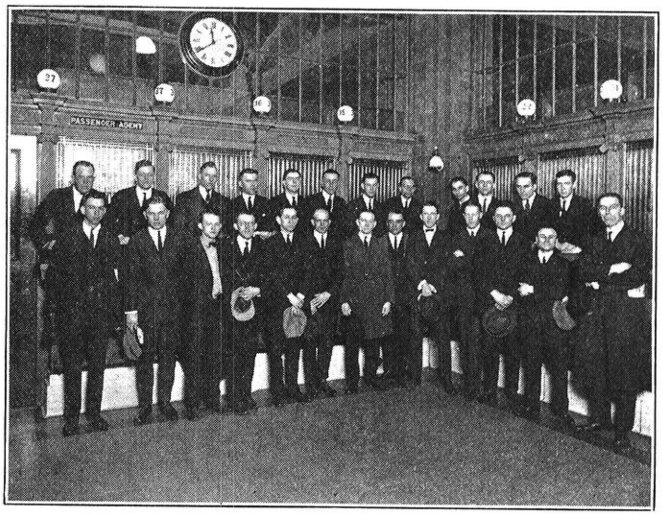
Members of the Mechanics department, their wives and Prof. and Mrs. Millar were entertained at a dinner party by Prof. and Mrs. M. O. Withey, Friday evening, April 21.

DEAN MILLAR'S DESCRIPTIVE GEOMETRY WINS RECOGNITION

"There is just one textbook on descriptive geometry that presents the subject in conformity with the way it is used in practical work", says Professor Ketchum, University of Utah, "and that book is the one written by Millar, Maclin and Markwardt of the University of Wisconsin". This should be an inspiration to the sophomores now struggling with the mysteries of descriptive geometry, and should show them that there is some object in drawing all those lines after all.

In a letter published in the Engineering News-Record of March 30, Professor Ketchum says, "For a number of years I have taught descriptive geometry from several different textbooks. New textbooks are coming onto the market continually. To my mind there is such a display of ignorance on the part of the writters of these textbooks that I am constrained to offer a few comments with the idea of helping some of your readers, especially those who teach the subject.

Forty-four civil engineering students—mostly juniors with a sprinkling of seniors—spent April 10, 11, and 12 in Chicago and vicinity on an inspection trip. They were chaperoned by Professors Kommers, Van Hagan, and Withey, and Mr. Stivers. The places visited included



JUNIOR CIVILS ON INSPECTION

About half of the party that looked over the Chicago & Northwestern Company's passenger terminal.

the Indiana Steel Company's plant at Gary, the Buffington plant of the Universal Cement Company, the Clybourn Avenue plant of the Northwestern Terra Cotta Company, the passenger terminal of the C. & N. W. Ry. Company, the freight terminal of the Soo Ry., and the tunnels of the Chicago Warehouse & Terminal Company.

The mining and metallurgy department is furnishing free of charge to radio fans the much sought for galena crystals, tested and guaranteed good for "detecting."

ALUMNI NOTES

(Continued from page 157)

ENGAGEMENTS

Art Lenck, c '21, is passing cigars, by way of announcing his engagement to Miss Ruth Krueger. Art is with the Sewerage Commission of Milwaukee.

MARRIAGES

Herbert Schrader, m '18, to Grace Hawley, Elgin Ill.

BIRTHS

Tr. Mr. and Mrs. **W. B. Bennett,** m '04,) a daughter, Jane Moffatt, Feb. 1.

To Mr. and Mrs. **W. G. Gibson** (g '08,) a son, Wynn Gordon, March 13.

To Mr. and Mrs. **W. P. Wolff,** (min '12,) a son, James Francis, Oct. 14, 1921.

To Mr. and Mrs. **R. A. Baxter,** (c '20,) a son, Ivan Pett, January 29.

To Mr. and Mrs. **Herbert Brown,** c '17, a daughter.

To Mr. and Mrs. **R. B. Kile,** e '15, a daughter.

Mr. and Mrs. **Stuart C. Lawson,** min '17, have announced the birth of a daughter, Jean Gertrude, on April 19.

Td Mr. and Mrs. **John Glaettli,** c '09, a daughter.

To Mr. and Mrs. **Rcbt. M. Connelly,** c '16, a daughter, Mary Patricia.

WHY STUDY ENGINEERING AT WISCONSIN? Having two faculty members named well forward in the list "Greatest Living Engineers" and being composed of many others of national reputation, the teaching force of our college surely cannot be charged with being theorists by even the most exacting cravers of vocational education. Students in Water Power, for instance, learn in detail how and why the project pictured on the cover of this issue, and others equally notable, were designed and built. However, the alluring talking points of the "Be an Engineer in Six Weeks" schools which emphasize their "practical" work, its entire absence from dull, dry theory, and its "inestimable" value of the student, cannot be applied to our college. It is the joint study of the two, theory and practice, under the guidance of men learned in both, that alone trains Wisconsin engineers. And as President Rea of the Pennsylvania railroad says, *training* in a college course is not longer merely an advantage; it is a necessity for the young man who aims at a place in executive forces.

ALTERNATING CURRENT RECTIFICATION FOR ELECTRIC RAILWAYS

(Continued from page 146.)

pool. The condensing chamber, arc chamber, cathode, and anodes are all water cooled, the water being circulated by a small pump in a closed and insulated system.

To start the rectifier, the ignition solenoid is energized. This lowers the iron rod which projects from the center of the condensation chamber. After touching the mercury surface, the rod springs back and starts the arc. If the load is of a highly fluctuating character an auxiliary anode is usually provided. It is excited from a single phase source, and maintains the arc if the load falls to zero.

A small two-stage vacuum pump is used with each installation. When the rectifiers are first put into operation, the pump exhausts the air to a pressure of 0.1 to 0.01 mm. of mercury, and pumping can be done at any time if the vacuum becomes poor. In practice the steel tanks have maintained this degree of vacuum for long periods with virtually no operation of the pump after initial evacuation.[1]

One of the characteristics of any mercury arc rectifier is that the loss (consisting of the product of the current and potential drop in the arc) is constant for all values of voltage. The drop across the arc is from thirteen to twenty volts, and is not materially affected by the long separation necessary in high voltage converters. This means that the higher the voltage at which the converter is operated, the higher will be the efficiency.

High overload capacity is also obtainable.

TABLE II.

Duration of Overload Minutes	% Normal Rating Permissible
2	300
5	200
10	150
30	125

Additional features are:

1. Small floor space. Can be placed in out-of-the-way places since all the operation is done at the switchboard.
2. Needs no heavy foundations.
3. Its simplicity and ruggedness adapt it to automatic substation work. It requires little more attention than a transformer, and would eliminate the high-priced attendance of its costly automatic substitute.
4. Units work perfectly in parallel. Any reasonable capacity can be made up by the use of a number of standard units.
5. Compounding can be provided.
6. No flashing or damage from external short-circuits.

As previously stated, over 100,000 K.W. in these units is already in use in Europe. A substation in Milan, Italy, uses two units, giving 500 K.W. at 550 volts. The Electrotechnische Zeitschrift[3] describes the substation at Hirschberg, Silesia, using three units—two 500 K.W., and one 250 K.W. They are mounted side by side on a metal framework, and occupy about as much space as a 100 K.W. rotary converter. One of the first installations was made in a steel mill six years ago. Recently the units were taken apart and no signs of deterioration were found.[4]

In conclusion; the entire field of small railway substation work seems open to a rectifier which will take the place of rotating machinery; and the steel-clad mercury arc rectifier, though a recent development, has proved itself to possess characteristics that adapt it to this field. It must be understood that the rectifier is not fitted for use in the large substation, but only in that great class of small stations where the saving in cost of equipment and buildings and operators' wages would be no mean sum. It seems certain that the American manufacturer will still further improve the large mercury arc rectifier and will place it on the market in this country, for the service of the electric roads and of the electric industry in general.

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[1] J. H. Milliken—Electrical World, Oct. 29, 1921.
[2] See the Electrician, Vol. 82, page 698.
[3] Electrotechnische Zeitschrift, No. 42, 1918.
[4] J. H. Milliken—Electrical World, Oct. 29, 1921.

Illustration from "De Re Metallica" by Agricola, published in 1546

Take It From The Air

NOT only music, but news, speeches, messages of every sort, are today being picked out of the air.

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These devices magnify the tiny telephone currents produced by the voice and supply them to the antenna, which broadcasts the messages. At the receiving end, smaller "trons", in turn, magnify the otherwise imperceptible messages coming to them from the receiving antenna.

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