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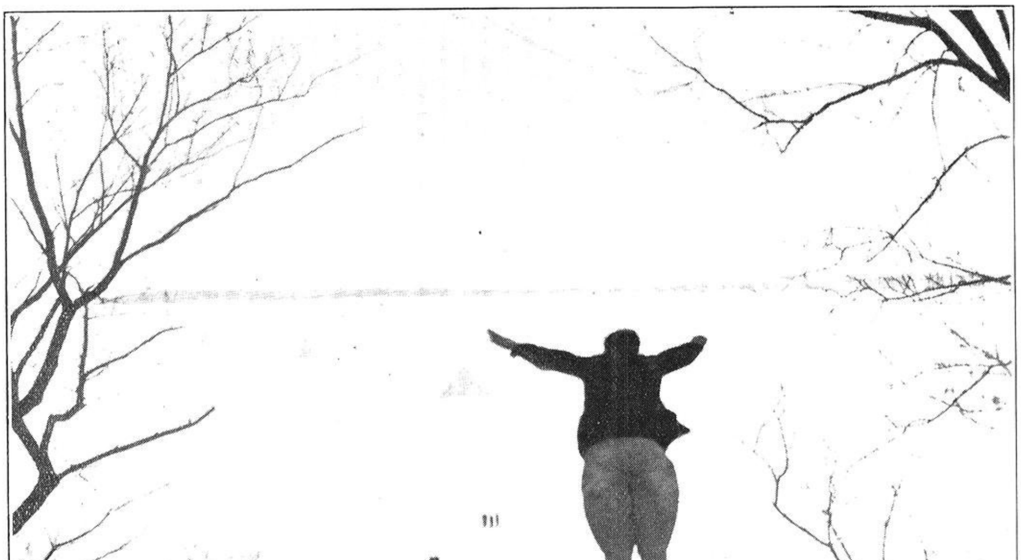

100 Feet Above the Lake
And only mere strips of wood to aid in alighting.
—RUUD PHOTO

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The Wisconsin Engineer

UNIVERSITY OF WISCONSIN

VOL. XXVI, NO. 4 MADISON, WIS. JANUARY, 1922

A THEORY ON THE MECHANISM OF THE PROTECTION OF WOOD BY PRESERVATIVES

By ERNEST BATEMAN

Chemist in Forest Products Laboratory

In the wood preservation industry a number of materials have been used to prevent the destruction of timber. Many of these are inorganic salts, which for the most part are very soluble in water. On the other hand, oils, such as creosote oils, have been used to a large extent and in general these oils are usually considered as being insoluble in water. We have then two types of wood preservatives which seem to be distinct from each other and have representatives of each type which are used very extensively in the preservation industry. It is a purpose of this paper to erect a hypothesis of the mechanism of the protection of wood against living organisms by means of preservatives and to point out the similarities and differences of the two types of preservatives. The theory of preservation thus obtained is not claimed to be complete, but it is at least a tangible working hypothesis which so far has answered all the questions raised against it and seems to fulfill the requirement of our present knowledge of the art of wood preservation.

That the life in minutes of the limnori, a wood destructive organism, is related to the concentration of the wood preservative fluid by the equation $YX^{3-2}=K$ was discovered by Mr. Bateman after forming the theory discussed in this article. The mathematical and experimental proof of the theory, which has required about three years of research work at the Forest Products Laboratory, is to be discussed in the February issue. Mr. Bateman hopes that ultimately the exact life of wood products under various conditions can be forecasted.

Living organisms which use the wood as food or as a protection against their natural enemies either take in the wood in some form or other into their structure, or at least come in very intimate contact with it.

There are at least two methods of protecting wood from from destruction by living organisms. First, by controlling the conditions necessary for the life of the organism and thus inhibiting its growth. Second, by the injection of a material which will kill or poison the organism itself or any enzymes through which it may accomplish its work. In general except in isolated cases, the first of these means, that of controlling conditions necessary to the life of the organism, is beyond our ability if we wish to use the wood for its usual commercial purposes, since it means control of the temperature, of the moisture content, and of the air content of the wood itself. We are ,therefore, forced to resort to the use of a poison.

If we examine the requirements of a good preservative, we see that the first requirement, therefore, is that it be able to kill the organism which attacks wood or destroy the agent through which this organism works. It would seem reasonable to expect that any material which is poisonous enough to kill an organism of any kind must first be soluble in the body fluids of that organism, at least to such an extent as to permit a lethal dose to be taken at one time. We have good evidence in support of this contention which is known to all, mercuric chloride or "corrosive sublimate" is a deadly poison to human beings, while its brother, mercurous chloride, is used in medicine under the name of calomel. They are both somewhat soluble in water, but the mercuric salt is from 5,000 to 18,000 times more soluble than the mercurous compound. We also know that if for some reason or other the condition of the patient taking calomel is such that slightly more calomel is dissolved than usual, then we have a condition known as salivation, which is the first symptom of mercuric poisoning.

In the treatment of wood with zinc we know that as long as the zinc is in the form of chloride or some other soluble salt, protection against fungus attack is assured provided there is a sufficient amount present, but if the zinc is present in the form of insoluble basic zinc chloride, little or no protection is afforded even if we have zinc enough to equal nearly half a pound of zinc chloride per cubic foot. The organisms which attack wood have as their body fluids chiefly water, so that in wood preservation at least it is necessary that in order for a material to be toxic it must first of all be soluble in water. The term "solubility in water" is, however, a very loose one and must be defined more closely. The

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*Delivered at the Sixteenth Annual Meeting of the American Wood Preservers' Association, Hotel Sherman, Chicago, February 10-12, 1920.

degree of solubility required is that which will permit of a water solution of a sufficient strength to be poisonous to the organism. In certain cases this may be a very strong solution indeed, if the material is not of a very poisonous nature; on the other hand, with extremely poisonous materials, the concentration required may be small enough to defy detection by our present means.

All wood preservatives must, therefore, be soluble in water to a certain extent, and in this respect at least, oil solutions and inorganic salt solutions must be similar. They differ chiefly in the mechanism by which they provide a reserve supply of the poison. At the present time, all inorganic salts are injected into the wood in the form of a water solution. In the case of zinc chloride, the concentration is a relatively dilute one. Van Nostrand, Chemical Annual, gives the solubility of zinc chloride as 209 at freezing and 616 at the boiling point of water; that is, the solution used in the treatment is only 1-40 to 1-120 of the amount of zinc chloride, which could be dissolved in the same amount of water. Wood treated with zinc chloride must, therefore, have all of its toxic zinc in solution, and the concentration of this zinc becomes weaker and weaker by any leaching which the wood might be subjected to. Sodium fluoride differs from zinc inasmuch as a nearly saturated solution is used in treatment. Wood treated with such a solution on drying leaves a supersaturated solution which eventually deposits solid sodium fluoride in the wood itself. This solid salt then acts as a small reservoir to keep the concentration of the preservative up to the saturation point and continues to act in that capacity until it is all used up. We might, therefore, expect that if this were the only factor to consider that it would take a somewhat longer time to leach an original injection of three per cent solution of sodium fluoride than it would an equal injection of zinc chloride.

With oils such as creosote a somewhat different condition exists. For the purpose of this discussion let us divide all the constituents of creosote oil into two groups; first, those materials which are soluble in water to a sufficient extent to render them poisonous. These we will call toxic oils. They may be hydrocarbons, such as benzene, toluene, xylene, naphthalene, etc., or tar acids, such as cresols, naphthols, etc., or tar bases, such as quinoline, isoquinoline, etc., or a combination of all three; their chief characteristic being that they are sufficiently soluble in water to render their water solutions capable of killing the wood-destroying organism. The second class of compounds are those which are not sufficiently soluble to render their water solutions toxic. This class of oils may be composed of the same groups of compounds as previously enumerated, and differ only in their relative solubility. They may even be soluble to a slight extent, and in all probability this is true. This class we will call non-toxic oil.

When creosote comes in contact with water, we then have the following conditions: The toxic oils are completely soluble in the non-toxic oils, and are partially soluble in water. These toxic oils will therefore divide themselves between the water and the non-toxic oils in such a manner that their concentration in water and is the non-toxic oil will be nearly in proportion to their solubility in the the two respective mediums. This is known as the solubility partition. For the sake of argument, let us suppose that we have one such toxic oil which is 50 times as soluble in the non-toxic oil as it is in water, and let us suppose that we use a 10 per cent solution of this toxic oil in the non-toxic oil. When such a solution comes in contact with an equal volume of water, the concentration of the water will be 0.2 per cent. If now the toxic limit of this water solution is only 0.05 per cent, then the water solution will be four times as toxic as is necessary to kill. Let us suppose that this water is withdrawn and an equal amount added, which in turn takes up its proportion of toxic oil and is rendered poisonous. This change of water in the case noted can take place 70 times before the concentration of the water is below the killing point, and even then the water solution would still be very poisonous, but not sufficiently strong to kill for at least 30 more changes of water.

In actual practice this change may take place either rapidly or slowly, depending upon the conditions under which the timber is placed. If placed where the timber is alternately exposed to wetting and drying, such as piling between high and low tide, we would expect a very high rate of solution with rapid depletion of preservative material. In dry places, such as telephone poles, we would expect a much slower rate of solution. The idea here is simply that part of the creosote oil prevents the rapid solution of the other part of creosote oil which is toxic and which acts as the preservative.

The information in support of this theory is as yet incomplete in respect to creosote oil, but such as it is, it confirms the theory. Perhaps historically the first data available on the solubility partition are furnished by Boulton in the Appendix of his "Antiseptic Treatment of Timber," where he shows that tar acids could be washed out of creosote by water. This is, of course, true, and if the theory here proposed is correct, it is necessary if protection is to be afforded by tar acids. Boulton does not, however, make a point of showing that although he used only 20 ounces of oil, yet it required 32 washings, using three times as much water as oil, or a total of 1,920 ounces, to reduce the tar acid content of the oil from 10 per cent to 1.5 per cent in one case, and from 17.5 per cent to 3.5 per cent in the other case. In other words, he used 96 times as much water as he did oil, and even then did not remove all of the tar acids. The attack of the teredo on treated piling after long service during which the creosote acted as a preservative is certainly a sure indication that the action of the water has dissolved out certain portions of the oil which were toxic. If this were not so, the teredo would have immediately begun its attack. The very fact that creosote oil protected for a time and then failed is sufficient to indicate that the toxic element has been removed.

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THE PROBLEM OF AUTOMOBILE SPRINGING

By A. S. Krotz,
Senior Mechanical.

There is a fairly definite opinion among automotive engineers that the development of spring suspension for automobiles has lagged behind other developments in the evolution of the motor car. As usual, the continental and, still more, the English engineer claims to have outstripped the American designer in car springing, although his arguments, and, more precisely, his results, are far from convincing. The smooth English roads have permitted the British designer to concentrate his attention on engine efficiency and miles per gallon of the precious gasoline or benzol.

"Riding on air" may sometime have a double meaning in automobile parlance and even rubber, too, has possibilities of displacing the present steel springs, the writer of this article points out. The characteristic riding qualities of well known cars are recalled and explained in one's mind while reading this discussion.

The Frenchman cares more for extremely high average speed, and the French roads offer some explanation for the bumping, jolting performance of French cars on American roads. France seems to have very few of what the American would call average roads. There the roads seem to be beautiful, smooth speedways or else a series of such jolts and humps as would tax even a theoretically perfect suspension by sheer amplitude of spring action. The French designer meets these conditions by using a set of stiff, sturdy springs which will not be needed on the straightaways, and which will absorb the worst of the heavy jolts on the poor roads.

In America we have done much to develop conventional springing, and the fact that the average engineering department is tied to conventional design seems to result from two difficulties. First, mass production does not lend itself readily to originality of design, especially where mass production itself takes on its new aspect of assembling standard components made by specialty production plants. The second stumbling block to American originality is in our buying public. Strange as it may seem, in America—the great experimental laboratory in democracy, the land of more or less freedom and self expression—originality is much more apt to be greeted by ridicule than by approbation. It takes a name like Westinghouse, or Marmon, to usher a really unusual springing idea to its place in the affections of our public. With these general conditions it could not be surprising if England had made some greater progress than we. Lancaster and Rolls-Royce are names that stand for the best in more or less conventional springing, but even here tradition has a weighty influence.

The technical side of springing, aside from any question of precedent or appearance, seems to be the provision of some means for insulating the car proper from such road shocks as are transmitted to the wheels through the tires. Due to the inertia of the unsprung portion of the load and the speed of the car it seems that no springing system can be devised which will impart reaction to the road equal to the energy imparted to the wheels. This indicates at once that unsprung mass must be kept as low as possible, and that the springing system must be capable of absorbing some energy, probably as heat of friction. This latter function of springing device is not of serious importance as far as heat disposal is concerned because of the relatively small number of B. t. u. to be absorbed, and the fact that this entire heat can be conducted through fastenings to parts of the chassis exposed to the air stream.

In reducing mass of unsprung parts more of our conventions may be called to trial by the possible elimination of the axle, at least in its present form. There is at least one English light car now being made with no front axle, and parallel leaf springs fastened one above the other across the front of the machine functioning both as spring and alignment member. This construction, like most other unconventional designs, necessitates provision of a separate device to aid in location of the wheels, and much of the popularity of leaf springs is due to fact, that this construction makes it possible for the springing device to function also as the aligning or locating member when used in connection with the usual axle.

It seems that this confusion of the functions of alignment and springing is apt to prevent or retard development of springing systems. It is instructive to see what conclusions one arrives at after separating these functions. When the car is in motion the road wheels may be assumed to follow fairly closely the contour of the road. Disregarding alignment and location of wheels which may be taken care of by other provisions, or partially by properties inherent in the springing system, we may assume that the only motion of the car with respect to the individual wheels is vertical. The function of the springing system is to retard the motion of the wheel relative to the body, with an increasing resistance so that, in case the magnitude of the bump is great, an acceleration relative to the road is imparted to the car and the wheel is prevented from exceeding its pre-determined amplitude of motion. In order that this may be continuously repeated it is necessary that the wheel, which is always in or near contact with the road, return to the same poison relative to the car. This necessitates the springing system transmit back to the road wheel the energy reecived from it, minus that energy absorbed in friction. The danger in absorbing too much of this en-

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SOMETHING FURTHER FROM "LAKESIDE"

By John Anderson,
Chief Engineer of Power Plants,
T. M. E. R. & L. Co., Milwaukee.

"Look for the place where the hardest work is; there you will find the fewest competitors", says Mr. Anderson, in advising students what to do after leaving college.

On the occasion of the visit of the Senior Engineers' Class of 1922 to Lakeside Plant, I stood up and looked at the hundred or more young men just completing their four years at College. I wondered what each of you would choose as a life study. Naturally I thought about the particular line of work which has furnished me with more than enough to do and to be interested in during the thirty years that have passed since I left school.

The graduate engineer does not, to any large extent, think of power plant work as an attractive field, and in looking at you I wondered why this should be the case. You seem to be the type of men, sound in body and mind, that would make good in a job where such qualifications are so essential, and yet I knew that a very few of you would be found in the list of power plant men of the future. The sales and manufacturing branches are bound to claim more than a fair share of your number. Why should this be? Is it that the promise of financial remuneration is greater? Probably so, and yet is the promise borne out as the years pass? On this I will not venture an opinion. I will, however, in all sincerity say that the power plant work offers a satisfaction that no other line, except that of invention, can offer to the engineer. Invention exercises the initiative and demands individual effort and thought. Power plant work offers similar opportunities for the development of the individual. Close application to the work of operating a plant results in economies that are highly valued, build reputations, and give a feeling of satisfaction that comes from doing a man's job well, a job at which only the strongest can succeed.

The engineer that can first design a plant and then operate it so that it will give uninterrupted service at least cost, will be always in demand. The same thing is not true of any other branch of the profession in as great a measure. Of course the power plant engineer does not, at least in his earlier years, play the spectacular part that his brother in the sales game does. He does not have the opportunity for travel, nor for meeting the many different kinds of men in all parts of the country. He is not called on, however, to wait outside the door of his prospective customer, nor does he have to forget a great deal of his college training in order to talk like a parrot on the virtues of the product he is representing, something that as an engineer he is not altogether sure of, but as a salesman talks for with his last breath. The power plant man is always a buyer, and as a consequence is in the very best position to exercise his ability as an engineer. The right to your opinion, the opportunity to exercise it and demonstrate that you are an engineer, is without price.

I have always valued my independence, particularly when meeting the many engineers that have called on me in connection with the purchase of equipment. A most amusing experience is to sit in as a buyer on the purchase of plant material, and interview three or four sales engineers, each boosting the particular product he has sent out to sell. Each uses the same kind of language, the same stereotyped form of argument, the same apparent enthusiasm, and expresses the same sincerity of belief in what he has to sell. Yet not all of this equipment can be regarded as even suitable, not to say satisfactory. from the power plant man's standpoint. It is he who must know. He must make the decision, and it is the other who must abide by his judgment. Which would you rather be?

Another very important matter should also receive the consideration of the young man making a decision at the conclusion of his college career. It involves the kind of life he will lead. The power plant engineer is much more liable to remain in one place, building up his reputation, improving his position, and finally reaching the best that can be offered by his employer, at the same time making secure his place as a citizen in the community as the result of his continued residence therein. These advantages will, of course, only become available as the years go on.

The work of a power plant engineer does not necessarily mean that he is eternally hot and dirty. It is not a rosy path for the lazy, however, but assuredly brings success to the worker. There is a satisfaction in hard work, measured in terms of success, that can be acquired in no other way. The man that chooses such a path is of the kind that invariably makes good.

The education obtained during a four-year mechanical course is all sufficient to fit out a power plant engineer as far as the teaching by others goes. After he receives his degree and gets a job, however, his education goes on, but on a different tack. He must now teach himself. He must first learn to understand men—all kinds of men from the illiterate foreign speaking laborer to the many different kinds of men in charge. He must understand them, particularly with regard to their nature. If he cannot get work out of, and work with and under such men, and still keep the reputation of being a good man to work under by the former, and a good man to have under by the latter, then he fails in the very first requisite of a power plant engineer. He can never expect to accomplish anything alone. Others must co-operate with him to carry out his ideas and orders. He must co-op-

(One page over, same column)

Reprinted in Eng-Contg Feb 8-1922 p 137
Abstracted in Mechanical Engineering April 1922 p 263

EXPERIMENTS SHOW MEASUREMENT OF VALVE LOSS DEPENDENT ON PIEZEMETER LOCATION

By CHARLES I. CORP,
Prof. of Hydraulic and Sanitary Engineering

Results of experiments to determine loss of head due to flow of water through gate valves have been published from time to time. In analyzing the data it was found that results were discordant. This was thought to be due in part to the difference in locations used for the downstream piezometer or gage opening by the different experimenters.

In measuring the loss of head due to a valve or other obstruction in a pipe line it is customary to determine this loss by taking the pressure difference as shown by two piezometers located short distances respectively upstream and downstream from the valve. There was little published information available to show the influence the location of piezometers would have in determining the loss of head due to a valve.

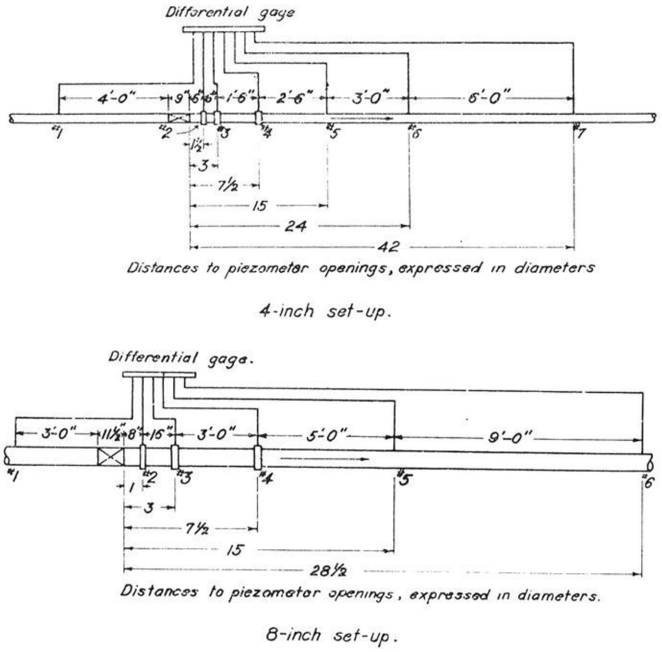


FIG. 1. ARRANGEMENT OF APPARATUS

During the school year 1919-1920, M. C. Neel and C. A. Willson, thesis students, experimented with a 4-inch and an 8-inch gate valve to determine this effect. Figure 1 shows the arrangement of their apparatus. The various piezometer openings along each main pipe were connected to the differential gage board where the head differences could be read. Figure 2 is a photograph of the 8-inch gate valve, part of the piezometer connections and the differential gage board.

The apparatus was first set up, in each case, without the valve in place and the loss of head due to pipe friction only determined.

The valve was then inserted and the loss for valve and pipe determined for a number of valve openings. The results from 1/8, 1/2 and wide open conditions for both valves are shown in Figures 2 and 4. To bring out more clearly the difference in loss which would be obtained by using piezometer 1 with 2, 3, 4, etc., the loss as determined from the last piezometer (No. 6 for the 8-inch and No. 7 for the 4-inch valve) has been regarded as the true loss and the loss as shown by the other piezometers divided by this giving the ratio of the two in each case. It will be seen from figure 3 that piezometers located within three diameters distance from the valve give in every case too large a loss, and that in the region from three to fifteen diameters downstream the disturbance of flow has caused the piezometers to register in an uncertain way.

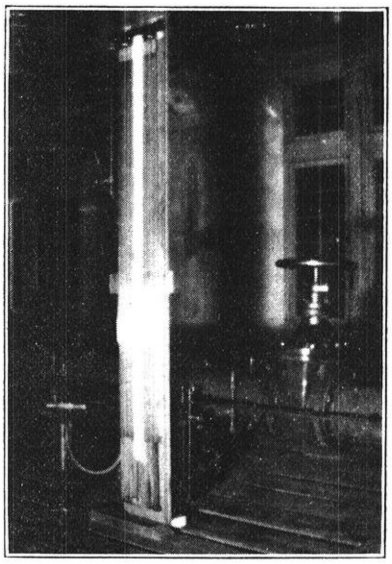


FIG. 2
PHOTOGRAPH OF APPARATUS

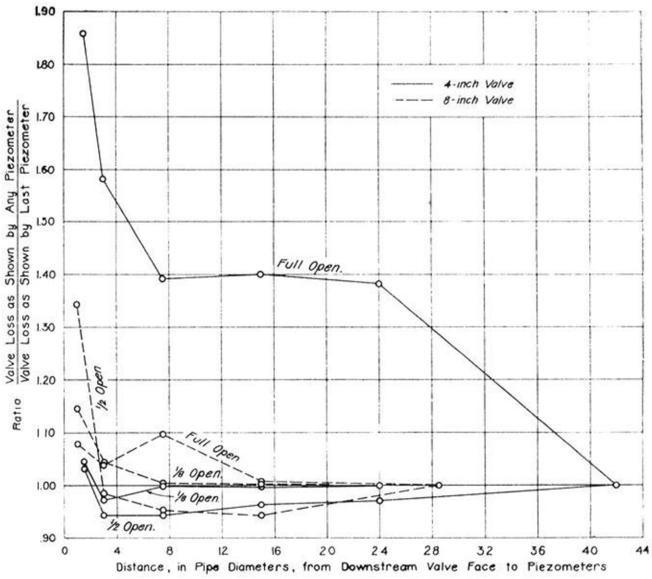


FIG. 3. RESULTS OF EXPERIMENTS

It will be noted also from figure 4 the loss is different from the normal pipe friction loss for forty or more diameters downstream but when a point from fifteen to twenty diameters has been passed this loss is negligible from a practical standpoint.

In figure 4 the loss of head in each section of pipe between the different piezometers has been shown. This loss as plotted is the difference between the loss when the valve is in position and that obtained for the pipe only.

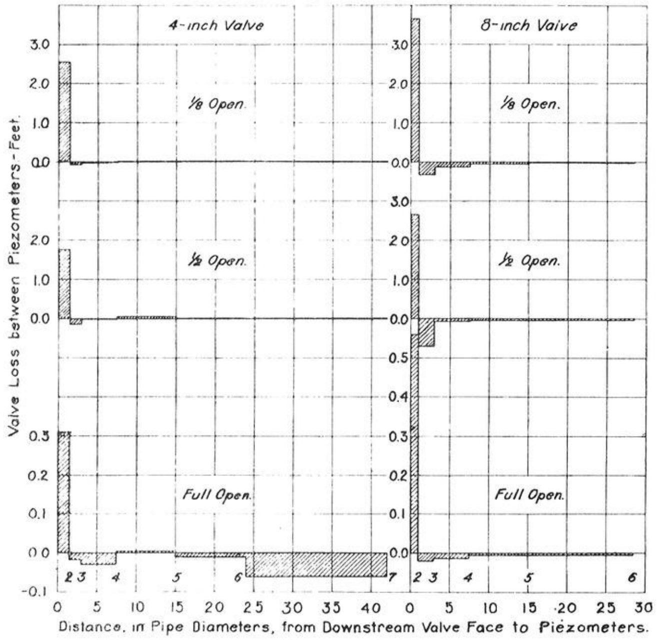


FIG. 4. RESULTS OF EXPERIMENTS

There is some question concerning the accuracy of the data from which the figure for the wide open 4-inch valve was obtained. This will be discussed in a bulletin on the "Loss of Head Due to Valves and Pipe One-Half to Twelve Inches in Diameter," soon to be issued by the Hydraulic Laboratory.

The negative value of the loss in sections 2-3, 3-4, etc., as shown in figure 4 indicates a partial reconversion of the velocity head back into pressure head.

It is concluded that a valve causes disturbed flow in the pipe line downstream for some distance from it and that a piezometer opening which is connected so as to be in this region will be affected, giving a false record of the pressure within the pipe.

Where there is considerable change of section in passing through the valve the pressure head absorbed at that point to produce the higher velocity of flow is partially recovered in the pipe downstream.

Further, if the loss of head due to flow through a valve be obtained from a piezometer within two or three diameters below the valve the result will be too large. Not until at least fifteen or twenty diameters of straight pipe intervene between the valve and piezometer will the reading show the true loss.

SOMETHING FURTHER FROM LAKESIDE

(Continued from page 60)

erate with others in order to be regarded as a man worth co-operating with.

Next, he must become familiar with the equipment he has in charge, what it was designed to do, and how far short it falls of doing so. His job then consists largely in finding that elusive difference. He has the education to do this, now he must apply it and, in applying it, support his education with the largest percentage of common sense he is capable of. He must be untiring in this regard. Long hours, fatiguing work, and unfailing patience are a big part of the price to be paid. This is particularly true in the earlier years. As he gains in experience and reputation, these less desirable forms of activity are taken up by those he has earned the right to select to work under him. The everlasting order of the day is work. He must work hard while he is young, that he may gain a position in his later years that will be worth all he gave to gain it.

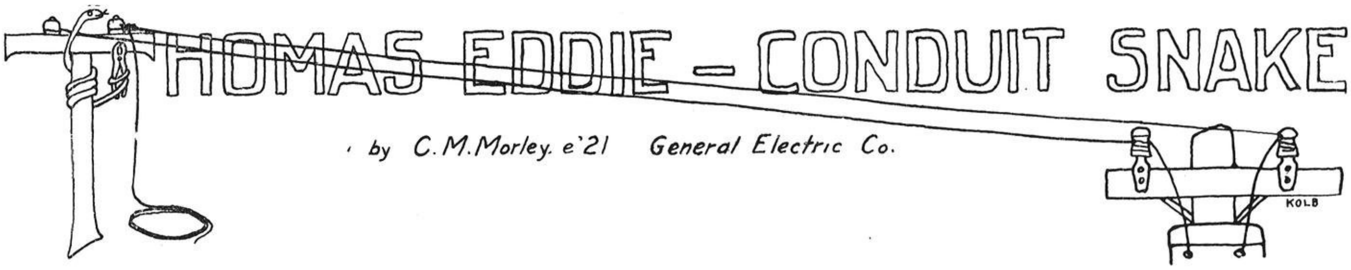
If I was to give you my advice as to what you should do after you have put your college years behind you, I would unhesitatingly say: "Look for the place where the hardest work is; there you will find the fewest competitors." Don't select the attractive position without considering how long it will remain attractive. Look over the men who have made good and note the road they have traveled.

The best men in power plant work are the men who have had no technical education to start with, but who have seen the necessity for it after years of practical experience and remedied the defect. This is because the technically trained man has never fully realized that, without a great deal of practical experience, he is a misfit. You cannot hold a position worth calling one, unless you know both sides of your job equally well. The power plant game has many opportunities, and there are big futures for those who are not afraid to work. There is a permanency about it that is missing elsewhere, and I sincerely commend it to your serious consideration.

Badger City Home of First Electric Plant

Wisconsin claims the honor of operating the first commercial electric plant in the United States, for findings of the Wisconsin Railroad Commission show that a plant was set in operation in Appleton, Wisconsin, on August 20, 1882, just two weeks previous to the starting of the Edison Illuminating Co. plant in New York City.

The electrical machinery of the plant consisted of a single 120 volt, D. C. dynamo capable of lighting 250 sixteen candlepower lamps. Since no commercial meters were then in existence power was sold on the basis of the number of lamps installed, a charge of $2 being made for each lamp per month when it was burned 15 hours daily and a charge of $7 per year per lamp for residence lighting. Even in the plant there was no measurement equipment, and the candlepower of lamps was judged by visual inspection. Fuse blocks, plugs, and lamp sockets were made of wood.



THOMAS EDDIE—CONDUIT SNAKE

by C. M. Morley, e'21 General Electric Co.

The old engineer, his midnight meal completed, pushed aside his ravished dinner pail, and picked up his pipe which lay on a convenient bench, already primed and loaded with the substance which the old engineer persisted in referring to as tobacco, but which, when in an active state of combustion, reminded the uninured bystander of a fire in a rubber factory. He struck a match and held it over the flame-scarred bowl, from which sundry gurglings presently emanated, reminiscent of the death rattles of the villian in the famous Ten-Twenty-Thirty success, "The Pirates Revenge." The pipe going properly, he leaned his chair back against the wall, assumed a gravely judicial air, and was thoughtful for a space. The young fireman had asked his opinion regarding the intelligence of certain domestic animals, and the old engineer was not one to cheapen his decisions by announcing them hastily.

"Well, son", he said at last, "I reckon you're right about chickens being the most witless of the inhabitants of the barnyard. Pigs, I should say, are the most panicky, while mules carry off first, second, and third place for pure and unadulterated sagacity. But enlarging the scope of our discussion, did you ever hear of a real smart snake?"

Then as the young fireman replied that he had never heard of any reptiles especially noted for intellect, the old engineer continued.

"I had a bull snake once that was the most sagacious serpent that ever leaves a track in a dirt road. And faithful! That reptile was that faithful that dogs are as fickle and vacillating in their affections as a red headed woman compared to him. He saved my life just a short time after I got acquainted with him; devoted the best years of his existence to my service, and finally—but mebby you'd like to hear the whole story."

The young fireman was all attention, and announced his intense desire to hear the tale; and taking a few great puffs on his pipe, the old engineer commenced.

"A few years back, before I started doing central station work, I was an electrician, and was working with a feller named Elmer Higson, who was a kind of a morose, ornery cuss, that no one but me could get along with. Elmer was fond of fishing, and in order to indulge this here hobby of his, we used to go out once in a while on little camping trips.

"At the time I first meets this snake, we were on one of these trips. We had stopped to heat some coffee for lunch, and I was working around getting it ready, when I hears a loud howl from Elmer, who was picking up fire wood. I came a-running, and found him as white as a fresh laundered shirt, and with his teeth chattering till it sounded like an air hammer. I asked what was wrong, and he points to a big bull snake, about four feet long, and as big around as your wrist, which he had

THOMAS EDDIE "TAKES A HAND"
"My weight stretched him out till he was about ten feet long and only five-eighths of an inch in diameter!"

picked up thinking it was a dead branch. The snake didn't make any move to get away, and seemed right friendly; and as I knew they were harmless, and wanted to have a little joke on Elmer, I bent down and stroked the reptile's head, which he seemed to take to. Elmer was kind of shamed at this, and wanted to kill the snake, but I wouldn't let him, and took it to camp, where I fed it a can of condensed milk that it tied into like a sot into corn whiskey. What with me saving it from Elmer, and bringing condensed milk into its life, that snake became may devoted slave from that time on.

"That afternoon we went fishing, the snake accompanying us, sliding along at my heel as faithful as the itch. In getting into the valley from the ridge, we had to go down a kind of a steep bluff. I reposed too much confidence in a small bush on the way down, and it pulled out with me. I felt it going, and hollered to Elmer, but he had no time to get to where I was. I was all set for a sixty foot drop, and was wondering if I would be busted up so bad that they would have to borrow a body to have a funeral, when my bull snake takes a hand. He flips his tail around my arm, and wraps his neck around a projecting rock, and holds on. I went down about eight feet, and then stopped, and swung there until I could get a foot hold. Then I looked up. Son, whatever do you reckon had happened to that snake? My weight had stretched him out till he was about ten feet long, and only about five-eighths of an inch in diameter!

"I got down, carrying him with me, and laid him tenderly on the ground, expecting that he would pass on pretty shortly. But after a time he recovered, and when we had taken him to camp and given him some more milk, he was as lively as ever. Of course after that I wouldn't have parted with him for money, marbles, or moon-shine. When we got back to town, incidentally, I had a gold collar made for him out of a broad wedding ring, carrying a statement of his exploit, which he always wore on state occasions, but not every day, on account of not having a well defined neck to wear it on, so that it traveled all over him.

"That evening this serpent proved his utility again. We had a small piece of canvas we used for a tent, setting up two sticks for poles, and stretching a rope from pegs across the top of the sticks to serve as a ridge pole. When we came to make camp, we found that the rope had been left behind. That caused a lot of good cussing to be wasted on the desert air, but the bull snake, seeing our trouble, hastily substitutes himself for the rope, and we pitched the tent as pretty as you please, and slept under it all night, the snake doing excellent as a ridge pole. He sagged some before morning, though, due to getting kind of tired.

"When the time came to go back to town, I was kind of puzzled as to how I could transport him, figuring that the train crew wouldn't take kindly to my having him in the coach with me, and not liking to leave him alone in the baggage car. But he solves the problem. When we got packed up, he crawls up to the tent canvas, which was all rolled up, and wraps half of hisself around each end, leaving his middle in a loop which ran across the top of the roll, and served as a handle. Altogether, he made as handy a shawl strap as ever you saw.

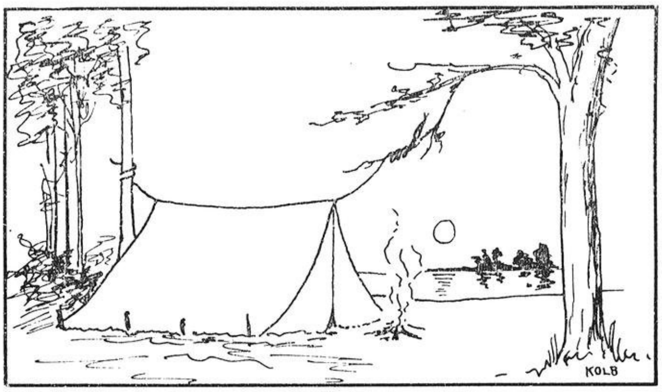
"Elmer and me got back on the job, and several days went by uneventfully. The bull snake went to work with me everyday, and stuck around catching insects, and watching me interested while I was running the conduit and then fishing the wire through it with a flexible steel tape. I could see that he was thinking deeply, but didn't know just what about.

"One day we was running the tape around an elbow, and broke it off. We were in a fix right, for it was the only tape we had, and we couldn't get the broken piece out. But the serpent, seeing our quandary, comes sliding up, slips into the conduit, and a moment later backs out with the end of the tape in his mouth.

"I was highly elated at this additional evidence of the snake's sagacity, and went out to get him a can of milk, while Elmer took the tape to the blacksmith shop to have it patched. When I got back to the building, my snake was nowhere to be seen. But some wire which I had left laying on the floor was slowly moving into a run of conduit. Pretty soon the reptile's tail emerged from the other end of the run, and then his head. In his mouth was the end of the wire I had seen moving. Yes sir! That snake had started out to be an electrician!

"I gave him his milk, and complimented him highly on his clevereness, and it was easy to see that he was overjoyed at having pleased me. Right there I named him Thomas Alva Edison, which monicker being too unwieldly for every day use soon gets contracted to Thomas Eddie.

"From that time on, Elmer and I don't fool with no tape. When we go to make a run of wire, Thomas Eddie



THOMAS EDDIE AN EXCELLENT RIDGE POLE

Although he "sagged somewhat before morning, due to getting kind of tired."

throws a small loop in his tail, in which we tie it. He then glides rapidly into a conduit, and appears at the other end in no time; fastening the wire to his tail, instead of his holding it in his mouth and so having to back through, enables him to travel with velocity.

"Now you would naturally think that Elmer would have been as proud of the snake as I was, he kind of contributing to its discovery and adoption in the first place, through mistaking it for a piece of fire wood. But he always remembered how scared he had been, and being ashamed of that, he always disliked Thomas Eddie, and pestered me to get rid of him, making suggestions like changing Thomas for a rattler, which, having a corrugated tail, would be easier to attach the wire to. I of course paid no attention to his talk, but Thomas Eddie heard him, and it hurt his feelings badly, he being a right sensitive snake; and I could see that such remarks didn't increase his liking for Elmer any.

"Elmer didn't do any thing that could be construed as an act of war for several weeks. By that time the snake had become an expert electrician, knowing just where to go with the runs of wire. One day I stepped out for a minute, and Elmer puts into effect a fiendish plan he has been turning over in his mind for some time. He waits till Thomas Eddie gets started through a conduit; then he grabs a hand generator that we used for testing, fastens one of its leads to the wires that Thomas was dragging, and the other to the conduit, and turns the crank like he was getting paid for it and the boss watching.

"You can imagine the fix of poor Thomas Eddie, inside that tube with no room to turn, the current shooting through his body from the stripped ends of wire which are fastened to his tail, and grounding to the conduit; it liked to finished him. But just about the time I came back in he jerks the wires off his tail, comes sailing out of the outlet box, speeds up to Elmer, and bites him in the leg. That started a pitched battle, Elmer grabbing everything movable around the place and throwing it at Thomas, while he did his best to get at Elmer. It looked to me as though one or both was going to be eliminated pretty previously, and the odds were against Thomas, his bite being harmless. But before either was damaged beyond repair, I stopped the fracas.

"I finally got Thomas quieted down, though it took four cans of condensed milk and an hour of soothing conversation. At the end of that time he was ready to forgive and forget, and to regard Elmer's little trick as being perpetrated in a spirit of frolic and banter, with no invidious intent intended. And Elmer, when I talked to him, didn't seem to bear any grudge, and claimed that he considered himself deserving of what he got; and I, being naturally trustful, believed he was sincere. Little did I know that his vindictive spirit was merely waiting a chance to get back at Thomas Eddie.

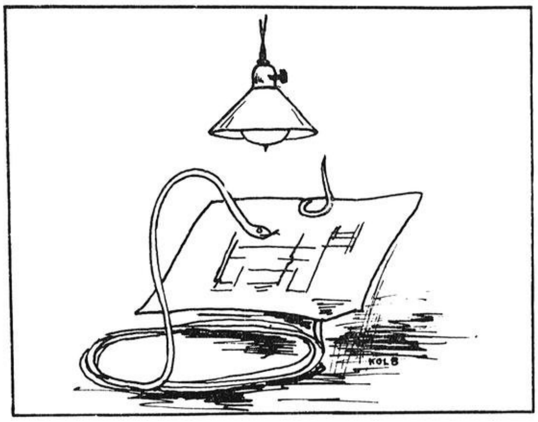
"About this time we got a big job to do in a hurry. It was a bonus-and-penalty proposition, and the quicker we finished it, the larger our roll would be. We, figuring on Thomas' help, calculated that we would be done eight or ten days before the time limit was up.

"However, we had a little bad luck. Some material didn't come, and that tied us up for over a week. And then Thomas Eddie fell down on me for the first time —and the last—in his life.

"He disappeared one noon hour, and didn't show up when it was time to go to work. I didn't go and look for him right away, figuring he was on some personal and private business of his own. But at last I got worried, and went out to search. I found him at last, sleeping peacefully in a corner under some rubbish. But this indolence of his wasn't the worst. That reptile had gone out and caught a rat, and swallowed it—which was why he had curled up for a nap. And that rat swelled him up till he couldn't any more get through a length of small conduit than I could.

"Elmer and I started the job using the tape, but it went awful slow, after we had been used to Thomas' speed. And we knew that, doing the work that way, we wouldn't get the job done within the time limit.

"Thomas didn't show up on the job for a couple of days, and when he did come, and realized what he had done, it pretty near busted his heart. I never did see a snake so contrite. He jumped into the work with a speed that even he had never showed before. And in the evenings, tired though he was from his day's work, he would never think of rest, but would stay up, pouring over the blue prints so as to know just how the next day's work was to go. It was worth a dollar and war tax to see him study those prints. He would coil us, crawling over to me on high, and indicated that I was to follow him at once.



PREPARING FOR THE NEXT DAY'S WORK

"It was worth a dollar and war tax to see him study those prints."

"I went over to the distributing box, where he led me, and looked as he seemed to wish. And I'll be gosh darned if we hadn't forgotten to make a run which went up to the third floor, and there branched and fed two lights.

"I hollered at Elmer, and told him to rush upstairs, and stand by the junction box, where the vertical run met the two horizontal runs that led to the lights. He was supposed to pull out the four wires that Thomas brought up, and then send him first along one branch, then along the other, dragging two wires each time. I stayed below, and fastened the conductors to Thomas' tail."

Here the old engineer relapsed into silence. He relighted his pipe, and stared pensively out into space. Then he spoke again, sadly and impressively. "Son, if I had let Elmer tie on the wires, while I stood by the box, Thomas Eddie might be alive today.

"Thomas started, and I watched the wire, to see that it didn't get tangled. About the time enough of it ran out to show that he was at the top, it stopped moving; and, except for little jerks, it didn't move for near five minutes. I fidgeted around, first on one foot, then on the other, for I knew that our time was getting powerful short. Then at last the wire started again, slowly; and all four wires moved at once. I couldn't figure this out, for only two should have moved at a time, as Thomas wired each branch. So I went running up stairs to see what was happening.

(Continued on page 70)

THE GREAT LAKES-ST. LAWRENCE WATERWAY PROJECT

That every person should be actively interested in making this project a reality was urgently asked by Prof. D. W. Mead in a talk before an A. A. E. meeting December 20. Eastern interests are selfishly and unwisely opposing the plan, and its final adoption requires that a general knowledge of its engineering and economic aspects be possessed by all interested in its success.

Dredging around 34 miles of rapids in the St. Lawrence river to allow passage into the Great Lakes to 80% of all ocean boats, making those bodies of water a veritable Mediterranean, and building a 1,500,000 horsepower hydroelectric power plant, the largest in the world, constitutes in short the Great Lakes-St. Lawrence waterway project. To be built at a cost two-thirds that of the Panama canal, it can be made to pay for itself by revenues obtained from sale of electric power alone within a maximum of 50 years.

From an engineering standpoint the project will be much simpler than the building of the Panama canal, but economically it will be of considerable greater magnitude. The traffic passing through Panama in 1919 amounted only to 6,800,000 tons, while about 11 times that amount, or 79,000,000 tons, passed through the "Soo" locks alone in 1920. A considerable portion of the latter tonnage was on its water and rail passage to the sea coast, increased by cargoes from the lakes along its route. Just what the traffic in the proposed canal will amount to cannot be said, for ocean boats will also use the lakes, just as they do the Mediterranean. Magnus Swenson, onetime graduate of our college and now president of the Norwegian American steamship line, says, "Much of our load is destined for lake territory; the first day this route is open, you will see our vessels poking their noses into lake ports". The present sea-ward traffic is estimated at 200,000,000 tons.

Shipping through Panama saves 5,300 miles of steaming around South America, but the saving in time by shipping through the Great Lakes will be nearly comparable. Time lost in the helpless congestion in New York, compared to time saved by efficiency of excellent loading and unloading facilities of the Great Lake ports, accounts for the saving. Freight travelling from Minnesota to ship-board at the New York harbor completes only half its journey when it arrives at the Hudson river, whereas the loading of most products on the Great Lakes is only a matter of hours, and in some cases only of minutes. Cartage and overtime charges in New York sometimes amount to two-thirds the value of the article, and normally as much as the railroad charges, which are many times in excess of what boat rates would be were a canal in existence.

Panama canal receipts are barely sufficient to operate the canal, but cash receipts from this great project will be sufficient to retire the investment in 50 years, engineers have estimated. At these figures, power can be generated at the plant 25 to 30% cheaper than at Niagara Falls. Government engineers estimate that 4,100,000 horsepower can be eventually developed from the energy of the St. Lawrence, although they recommend that only 1,464,000 horsepower be utilized since the lack of a market for a larger amount would make its development unprofitable. The installation cost is to be about $110 per horsepower, amounting to about two-thirds of the cost of the entire project.

Estimates of the total cost of the canal were made for two depths, one 25 feet and the other 30 feet. For the former depth a total cost of $252,727,200, including the cost of the giant power plant, is estimated. An additional $18,000,000 would dredge the channel to a depth of 30 feet, which Prof. Mead thinks is advisable at this time, although it can be done at any later date.

Financing of the project, it is thought, can be done without government appropriation. A financing board, consisting of representatives from both Canada and United States and having government guarantee of bonds, could provide the construction and initial operating costs.

Selfish opposition on the part of eastern states has been the only drawback to the expedious adoption of the plan. New York state wants its barge canal utilized, and although the canal can carry only a small fraction of the freight, estimated at 2 or 3% of the total, officials of that state are opposing the project. That this opposition is not legitimate is proved by a statement of Herbert Hoover, who says, "I have regretted very much to see the local opposition in New York City to this project. I have indeed felt that it is based upon the same attitude of mind that objected to the use of labor-saving machinery. Every factor that we can introduce into our tools of production that decreases the cost of production and serves to increase the standard of living of the American people is something that we should aspire to achieve."

That the decision as to whether or not the water-way should be built may be settled upon purely economic grounds is hoped by people interested in its construction. It is thought that the question will be brought up at the present session of Congress. Public opinion can do much to make the project a reality if only the plan and its nationwide benefits are understood.

"Out-Spinning the Spider", an attractive publication telling in an interesting manner the history of the wire rope industry as sponsored by John A. Roebling, has recently been sent to our magazine and is now available at the Engineering library. How all sizes of wire, even as small in diameter as 1-4,000 of an inch, or twelve times finer than the human hair, are made is also told by the author, John Kimberly Mumford, who has written books on other industrial subjects.

OPPORTUNITIES FOR THE ENGINEER IN FOREIGN COUNTRIES

ANTHONY F. ROHLFING,
Senior Civil

The Tau Beta Pi essay chosen for publication.

What a fascination foreign countries hold! Their magic charm has ever led man to forsake the security, safety, and comforts of home and face the perils, dangers, and hardships of the tropics, arctics, and wilderness. Always restless, always longing, man is constantly pushing his way into the unsettled parts of the world, until today even the extreme polar regions have been penetrated. The engineer, adventure personified, builder of the sinews of industry, has and must always be a leader in this subjection of primeval lands. The soldier, after grasping the true significance of the engineer, has called him rightly "the pioneer".

This searching after golden opportunities has even in prehistoric times been one of the great motive forces of civilization, but today new forces have arisen that give a new impetus to this alluring quest. Staggering under the heavy burdens left by the Great War, European nations must find new wealth to replace that which has been destroyed. This wealth is most speedily and readily obtained by the exploitation of new and undeveloped regions. At home, the European engineer has but few opportunities, for the countries are too poor to undertake more than the most necessary engineering projects. Moved by the double force of his own incentive and the encouragement of his government, the European engineer wasted little time after the end of the war in seeking opportunities in foreign fields; bu this path is easy no longer, for every day he is facing stronger competition by his American brother. With the passing of the frontier and with the enormous growth in wealth, until today she is the richest country in the world, the United States is obliged to consider more seriously than ever, trade expansion into foreign countries. To this movement of expansion the engineer plays the role of advance agent. Impelled by the dauntless spirit of their pioneer forefathers these Americans will make worthy competition for anyone.

Nor will these engineers have to seek very far, for opportunities exist right in their own "back yard." Europe has Spain, the Balkans and enormous Russia while the United States can seek an outlet to the south in the nearly virgin Latin-American countries. In Asia, especially Siberia and China, hold out innumerable possibilities. Africa, consisting mainly of colonies, does not invite foreign engineers, for European nations have ever held that the colonies exist for the benefit of the mother country only. All these regions, rich in natural resources, offer great opportunities not only for the engineer but also for the capitalist and the business man.

Our interests center mainly in the South American republics. A study of Brazil, the largest country in South America and larger than the United States, reveals conditions as they prevail over the whole continent. But a small portion of the interior part of Brazil has even been penetrated. Only a few maps of widely scattered districts exist, as no systematic survey corresponding to our geodetic survey has ever been made. The total length of Brazilian railroads is fourteen thousand miles, or equivalent to the mileage that the United States had at the beginning of the Civil War. These railroads penetrate into the interior a distance equivalent to that between Cleveland and New York. Imagine these primitive conditions existing in a country teeming with vegetation while in parts of the world people are starving. These conditions are applicable to any South American country removed from the ocean.

Lack of care, together with instability of governments, impassable mountain regions, and a fever ridden climate, have been the main obstacles to progress. Water power, though available in the mountainous districts, has been used but little. Chile is leading the way though, for it has just let a contract to an American concern for the electrification of its main railway. The characteristic feature of the South American railways are their shortness, their lack of connection with other roads and the fact that many are only narrow-gage roads. Highways are nearly in as bad a condition as railways, but an era of highway building has come with the introduction of the automobile.

The sanitary conditions are deplorable. Only the largest cities have water supplies and the quality of the water of some of these is far from satisfactory. What is still worse is that there seems to be no desire to improve conditions in this respect. Sewerage and garbage disposal system are rarities outside of the large cities.

These are the conditions in a country rich in agricultural, mineral, and other natural resources. There can be no doubt of the future, but what of the present? To develop their resources, the South American countries need not only engineering skill but also business ability and capital. All three are essential and must be furnished by any one who wants to gain a foothold there. It was because European countries furnished all three requirements that their engineers were preferred before the war. Now that America has the wealth to back the ability of its engineers and business men and that the Americans are well liked it seems probable that they will have the advantage.

It is not advisable for an engineer to go to South America if he has no definite work there. This is especially true if he does not know foreign languages or has no recommendations. As the majority of the engineering projects are usually on a big scale, there are only a limited number positions open. In the more desirable regions the wages do not amount to more than here. It is only in the remote fever-ridden districts that salaries are higher.

(Continued on page 77)

Published in Sibley Journal same month

WHAT MATTER IS MADE OF

Molecules, Atoms and Electrons In Relation to Our Every Day Problems

By DR. W. R. WHITNEY,
Director Research Laboratory, General Electric Co.

Those who are inquiring into things are always disturbing the comfort of our old ideas. The scientist, who is in truth, what the amateur is in sport, tries to learn what makes everything and how the work is done. He is daily learning more, so that former views are constantly improved. At present a new picture of stuff is being painted. A new book should be written—"The Elements of the Elements."

Like our old atom, impossible of partition, we now have its indivisible subdivision, the electron, but fortunately for simplicity, instead of seventy or eighty, as with the atoms, we have but two of the new units—the positive and the negative electron. The myriads of complications which correspond to all the differences in matter about us, must reside in the arrangements or combinations of these two simple components.

The things which have forced this new chemistry and physics upon us are fairly familiar. The interconnection may not be evident. Such names as electrons and atomic structure do not convey to the mind inherent relationship with radio, radium and X-rays. But a proper view of matter as it is now understood can most readily be pictured by getting the connection among some such group of present-day subjects.

We are now forced to look at all matter as composed of identical, small, electrical charges, which determine the character or nature of chemical elements and compounds by the numbers and arrangements in space. Under this plan, an atom—the ultimate particle of a particular substance—becomes more like a solar system than like a solid. The volume of the atomic space is mainly unoccupied, but through it the forces act which are attributable to electric charges within.

Becquerel, who found that a certain uranium ore emitted an invisible ray capable of passing through black paper and still affecting a photographic plate, was partly responsible for our new views. Soon afterward, the Curies discovered radium, and this was shown later to be a naturally decomposing atom. Several other decaying elements were also found among the heavier ores. During this process of decomposition small electrical quantities were continually discharged.

Similar discharges had already been found in other fields, but were not understood. For example, when the filament of a lamp is heated in a high vacuum, negative electrical charges are emitted and current thus crosses the empty space. This had early been noticed by Edison. It was not until after the discovery of radium that the true meaning of these "electrons" was understood.

When these little units of negative electricity flow within a wire, they constitute the electric current. When, by high temperature, they are emitted from a metal, they are called thermions. When they pass through a gas with sufficient velocity, their impacts decompose molecules, and the greatly augmented flow of the resulting charged particles produces the common electric arc. When they flow through a vacuous space, under the influence of a high electric force, they are called cathode rays. When their motion is stopped by impact in the surface of a solid, the sudden change of motion starts an electro-magnetic wave, which we call an X-ray (just about as a drum beat sets up a sound wave in air), and when they surge up and down a wireless antennae they produce the long wireless waves through space.

This being known, it is easier for us to imagine how ordinary visible light may be due to similar changes in motion of these electric charges, because light waves are only long X-rays, or very short wireless waves, and all three are propagated through space at the same speed.

When constituent electrons are arranged in the groups called atoms, all properties seem determined merely by geography, or orientation. Apparently such old established things as chemical activity and valency are due to the number of those electrons which occupy the outer surface of the groups. The shooting electrons of the cathode ray, stopped by the platinum or tungsten target, produce the X-rays, which by reflection in crystallized matter, disclose its atomic arrangement and thus lead to better understanding of many physical properties.

Because electrons may be driven out of a metal by heat and carried through space by an electric force, it has been possible to develop all the various wireless receiving, amplifying and oscillating, devices now in common use. They are all based on motion and control of electrons.

Since decomposing elements emit electrons, since heat drives them from filaments, since gases and air yield them on impact in arcs, since statically charged bodies carry them and lose them (as a car gains or loses passengers), it is logical that all electric currents are attributed to their motion, all static charges to differences in concentration, and all matter to balanced combinations of them.

Why isn't there a cement walk across the upper campus between the Engineering building and the Law school? At this season of the year the path which exists there is nothing more than a mud hole,—unsightly and precarious. From Park street to North Hall there is no real means of crossing the upper campus. One sidewalk in this space is not enough. The dirt path should be replaced with a better walk.

EDITORIALS

"STILTS OF CIVILIZATION" That professional engineers are coming more and more to the attention of the public is evidenced by the clipping below which was taken from the editorial page of a daily newspaper.

Here is a very useful organization, standing out among many worthless ones, like a blackberry in a bowl of milk. The American Association of Engineers! It has 24,000 members. Hopes eventually to enroll the 176,000 engineers not yet in the fold.

Lucky, that we have so many. In grandpa's day, the best brains went in for law and other professions. The best brains these days go in for engineering.

Engineers built our Panama canals, railroads, sewage systems, water supplies, flood controls. They lay out better cities, reclaim land, build highways, originate giant industries—master minds of electricity, chemistry, hydraulics, machinery and higher science.

Without engineers, no civilization; also mighty few jobs. Few in number, they are the stilts on which civilization stands.

The American Association of Engineers has exceedingly worthy objects and it merits all of the wonderful success it has thus far experienced.

A man can always sit down and read, but not—think. It is with thoughts as with men: they cannot always be summoned at pleasure; we must wait for them to come. Thought about a subject must appear of itself, by a happy and harmonious combination of external stimulus with mental temper and attention. *Schopenhauer.*

POLITICS AND THE WATERWAY Petty squibbling and squabbling by politicians intending to forestall adoption of the Great Lakes Waterway plan reminds one that not yet is settlement of momentous issues made upon economic bases. Engineers have reported that the project will pay for itself in 50 years, business men have declared that it can be financed without a single cent of government appropriation, and economists estimate it will save the nation hundreds of millions yearly, but the ever-present know-it-all politician opposes it, openly declaring a power trust responsible for all agitation in its favor, and, we suppose, silently lamenting that he is not a part of said power trust.

In direct contrast to our waterway program is the fact that France is at present building a 50-mile canal and actually *tunnelling* under 4 3-8 miles of hills in order to save a few miles of boat passage from Marseilles to the Rhone. The tunnel is said to be the widest in the world, measuring 72 feet in width, and is to be 45 feet in height and 13 feet deep. Practically no appreciable engineering difficulties are to be encountered in the Great Lakes-St. Lawrence project.

Sometime in the future, only men who know will decide or will influence public opinion in the settlement of like questions, but to believe that that time has come is certainly erroneous.

THE CARDINAL "All the news that's fit to print" plus generous glimpses of the more intimate, the inspirational and significant side of campus life form the contribution of The Daily Cardinal to the student body of the University of Wisconsin.

This magazine believes The Cardinal's contribution immeasurable in its value, and desires, in this number, to express the appreciation of the engineering college to the corps of workers whose energy, insight, and vision have made the paper representative of the Wisconsin spirit and enthusiasm. The eagerness with which it is daily sought and read, the reliability placed upon its contents, and the esprit de corps of its large body of staff workers all attest to its popularity.

Not until an editor of one of the influential national magazines commented on the high quality of the Cardinal did many of its readers wake-up to a knowledge of the part it was playing in their school life. Handling student questions in much the same manner and with much the same success as the largest newspapers handle civic problems, giving active support and publicity gratis to all student activities, and capably representing the university throughout the state, it is indispensable in successful college life.

Paying one's "three-fifty" in subscribing to the paper and eagerly awaiting its daily arrival constitutes only in part a payment and appreciation of its services. Although highly systematized, the work of the staff is not that of an automatic machine, as one who does not appreciate the innumerable troubles of publication may think. Each little news item, each inch of advertising, and each paragraph of editorial matter represents in unremunerative expenditure of time many hundreds times the amount consumed in leisurely reading the same article, advertisement, or editorial. Thankless indulgence of such service is poor encouragement to such willing workers.

It is hoped that readers of this magazine will recognize the high standards of the Daily Cardinal and give the institution their active support and outward appreciation.

The scientist is in truth what the amateur is in sport
Dr. W. R. Whitney.

THE POETS OF THE FUTURE A collection of college verse produced during the past year has been received for review by our "literary editor". We are nothing if not catholic in our tastes, wherefore we venture to drag the subject of poetry into these tectonic precincts.

Wisconsin fails to finish in the money this year, although mention is made of one Wisconsin poem entitled "Don't Spoil My Circle." It has an engineering sound and may be the wail of a frosh draftsman who fears someone will jog his elbow, or perhaps it is the protest of the senior civils who object to having the Dean "knock the corners off the circle" in the class in concrete.

Modern poetry is like olives; the taste for it must be acquired. Try this "THOUGHT",

"On busy days
When hopeful-fashioned
Flowers and clouds
Are passed unnoticed:
God must be very lonely."

Honest to goodness, that's just the way it's written.

A glance over these poems reveals that the word "God" is freely used by modern versifiers. It's the punch as "Hell" was not so long ago. We prefer ours without.

If you like intimate verse, the "Boarding School" will suit you. We are told that,

"The girl in the room above
Had beautiful lingerie,
And exquisite manners,
And immaculate hands.
She had the reputation for telling
The smuttiest jokes of anyone in school."

"GONE" will grip you lovers of Nature. When you read that "The *hairless* trees were talking wildly", you will doubtless talk wildly yourself. So this is poetry!

"The Poets of The Future" is an entertaining volume, but it is marred, unfortunately, by one poem so vicious in its sordid irreverence that not even poetic license can justify it.

"The great lesson of the present situation is that there is a certain fair and proper adjustment of the relations between the people employed in all of the various occupations. It is a natural adjustment, made by the people themselves in selecting the work they shall do, taking account of their abilities, inclinations, and all of the conditions surrounding employment." *National City Bank.*

BOOK THIEVERY The Librarian reports the loss of books from the reading room. The liberal regulations that govern the use of books belonging to the college make thievery quite indefensible. If any of our number is laboring under the delusion that walking off with a library book is a real devilish stunt he should be firmly dealt with by his friends—say beaten to death with lawyers' canes. It is so easy to walk off with a book under our library rules that there is no sport in the deed. A certain percentage of loss is to be expected; among 1250 students there are sure to be a few crooks. So long as the percentage loss is low it will not interfere with our library privileges. If it grows unduly, we will find ourselves excluded from the book shelves and standing outside an oak railing. The many will have to suffer curtailment of privilege because of the cussedness of the few.

THE PROBLEM OF AUTOMOBILE SPRINGING

(Continued from page 59)

ergy lies in making the springing sluggish, and causing the tire contact to be intermittent.

The conventional leaf spring absorbs energy through friction between leaves, and stores and returns it through its property of resilience. In spring steel this resilience is only about 95 ft. lbs. per cu. in. of steel, and with an average initial load on each wheel of one-fourth the car weight and an amplitude of motion of something over six inches it is clear that a steel spring must have a considerable mass. In discarding convention and casting about for the best medium for temporarily absorbing and the returning energy, we would probably think first of a gas such as air. There would, of course, be no possibility of exceeding an elastic limit in this case, and the difficulties in using a small volume of air for the springing medium would be entirely mechanical. Another promising medium is found in rubber, which is already used almost exclusively for springing aeroplane wheels. The resilience of vulcanized rubber is 14,600 ft. lbs. per cubic inch, as compared with 95 ft. lbs. for spring steel. Either of these two materials—gas or rubber—could be used and a very much lighter system developed. The actual absorption and dissipation of energy could be taken care of by a separate unit, as an enlarged shock absorber, which in itself as now fitted is an admission of the inadequacy of the leaf spring to perform both functions of storing and absorbing energy.

The other problems such as periodic motion of the springing device causing pitching or rolling of the car could also be handled to better advantage by isolating each necessary function of the entire suspension and solving it, if not independently, at least in such a way that it may be performed effectively and at a minimum weight.

The result might quite conceivably be a suspension very much superior in "riding qualities" to our present conventional systems, and certainly no hevier, if not appreciably lighter.

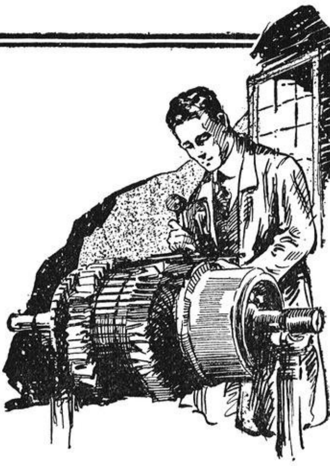
THOMAS EDDIE, CONDUIT SNAKE

(Continued from page 65)

"Son, when I got up stairs, I witnessed one of the most affecting sights of my entire career. I saw that serpent immolate himself for me — yes, sir, deliberately give his life to carry out my plans. When he had got to the top of the vertical run, he found the cover still on the junction box. That ornery Elmer, determined to revenge himself on the snake, hadn't taken it off. He figured that he would tie up the work till after twelve o'clock, and that I would think Thomas Eddie was to blame, and, on account of being mad over the penalty we had to pay, kill him.

"Poor Thomas Eddie waited and waited for the cover to be taken off, so he could draw the wires out. He, being naturally guileless and trustful, never thought of treachery, and likely figured that Elmer wasn't there yet. Then as time went on and he realized that only a minute or two was left to complete the job, he knew

(Concluded on page 73)



This Junior is learning to be a banker

IF you are putting in three hours a day in the electrical lab, don't be surprised twenty years later to find yourself promoting a public utility bond issue. Or if you start in newspaper work, as like as not later on you will turn to manufacturing or advertising or law.

You don't know where opportunity or inclination will lead you. This fact has a great deal to do with your work at college—not so much the things you learn as the way you learn them.

Don't think of education as a memory test in names and dates and definitions. That knowledge is important, but only as an incidental. Of far greater value is the habit of getting at underlying laws, the basic principles which tie facts together.

The work of the pioneers in electrical experiment, at first glance confusing, is simplified once you realize that much of it hinged upon a single chemical phenomenon, the action of the voltaic cell.

Analyze your problems. Look for fundamentals. Learn to connect a law or an event with what went before and what comes after. Make your education a training in logical thinking.

This ability to think straight, whether acquired in Engineering or Arts, is the biggest thing you can get at college. Its aid as a means to success applies equally to whatever work you take up—since mental processes are the same everywhere. It is the power which enables a mechanic to become sales manager, a lawyer to head a great industrial organization. Develop it, if you would be ready when your big opportunity comes.

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

Western Electric Company

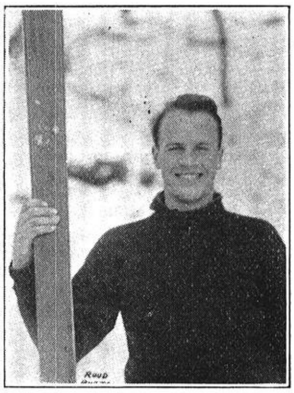
The executives of this Company have been chosen from all branches of the organization. It doesn't make much difference where you learn to think straight, so long as you learn.

ATHLETICS

H. A. PHILLIPS

SKI JUMPERS ARE ENGINEERS

The picture on the cover this month shows Tom Norberg jumping from Muir Knoll, and Hans Gude is shown on this page. These two men, together with Sverre Strom and Sven Kvaven, will represent the University at the National amateur ski championships at Cary, Illinois, January 22. They belong to the Badger Ski Club, organized some four years ago on account of the great need for a club of this sort at the University. Hans Gude is captain of the team and Tom Norberg manages the slide.



HANS GUDE

Skiing at Wisconsin has always been popular, but it remained for the Norwegian students to put the school on the map, for to these boys skiing is as natural as walking. Two years ago a dual meet was held with Minnesota, in which Wisconsin was the winner, and a similar event is on the card to take place some time in February this year. A cross-country race and jumping events will be on the program.

Wisconsin seems to be a favorite school for the Norwegian boys, who are all engineering students. They run a house on the fraternity plan, and are prominent in many university activities. Gude is a football man, and is also on the track team. Last year he took second in the National ski championships at Cary.

The Wisconsin ski club is not limited to the Norwegian boys, however, for the club has a large and enthusiastic membership from the whole student body. But it is pretty hard to beat these boys at their own game.

INTERCOLLEGE CONTESTS

A program of many intercollege contests, all counting for points toward the Nelson trophy, is being arranged by the athletic department. These include track meets, wrestling, swimming, basketball, gymnastics, and other events—sufficient in number and variation to afford every engineer an opportunity to engage in at least one sport.

The inter-college track meet is to take place Saturday afternoon, January 21, in the gymnasium annex. Track is counted in the Nelson trophy contest as a major sport, and every engineering student who possesses any ability in either track or field events should be on hand. Last year the Engineering College won both indoor and outdoor track meets, and it is up to the plumbers to repeat.

BASKETBALL

Coached by Dr. Walter Meanwell, basketball mentor supreme, the Wisconsin basketball five promises to make a very creditable showing this year. Due largely to Dr. Meanwell, Wisconsin basketball teams have been so successful as to mark the Univerity as the strongest in the country in this sport.

Last year "Doc" returned to Wisconsin after an absence of three years and coached the team to a triple tie, on a percentage basis, for the conference championship. Michigan and Purdue were the other leading teams. Wisconsin had a reasonable claim to superiority in the tie, however, as the team defeated Michigan both games, while the latter took two from Purdue.

With Ceaser, Taylor, Williams, and Tebell of last year's team, Doc's principal worry has been to develop a center, and he appears to have a find in Gibson, a sophomore. Other men who will surely get into conference games are Gage, Johnson, and Irish, the latter an engineering student who also looked good in football.

All those familiar with the Meanwell style of play know that the success of the game depends on the superiority of his teams in the floor game, which means hard drill in the essentials of passing, and great emphasis on teamwork. Regardless of just how the Wisconsin basketball team may come out this year, it is safe to say that the five is one of the fastest recently seen at this school, and when the last game has been played they will stand well in the percentage column.

CREW

Up on the rowing machines in the gymn annex "Dad" Vail is training the crew prospects. When the ice breaks up the crew will be on the water, in fact, half a dozen of them will be. Watch the crew, for rowing is teamwork in its highest form. No other sport demonstrates so clearly the value and necessity of teamwork.

The conference championship meets in wrestling and gymnastics were awarded to Wisconsin for this year, and will take place at the gymnasium, March 17-18. These sports, wrestling in particular, seem to be of growing importance in the midwest, where they have not been so popular as in the east. Coaches Slaughter, gymnastics, and George Hitchcock, in wrestling, have done a great deal to increase interest in these sports at Wisconsin.

ALUMNI NOTES

E. D. Bader

ENGINEERING SOCIETY OF WISCONSIN TO MEET

The Fourteenth Annual Meeting of the Engineering Society of Wisconsin will be held February 24th and 25th in the Auditorium of the Engineering Building. The annual banquet will be the night of the 24th at the University Club.

The society has over twenty committees covering the various fields of engineering activity and each of these will report briefly on engineering work in their line.

The officers of the society are Chas. I. Corp, president; Jerry Donohue, vice-president; Leonard S. Smith, secretary-treasurer, and F. J. Deutsche, W. P. Hirschberg, F. R. King, F. W. Ulluis, Jr., Board of Trustess.

Wisconsin graduates who have recently become members are **L. C. Rockett**, Oshkosh, State Highway Commission, **A. E. Kringel**, City Engineer, Green Bay, **G. W. Trayer**, Research Engineer, Forest Products Laboratory, **M. M. Isabella**, Highway Commission, **C. A. Halbert**, Railroad Commission, **W. H. Ryan**, Contractor at Janesville, **J. H. Waite**, Manager, Waukesha Cement Tile Company, **J. W. Tanghe**, and **Alfred Brill**, partnership, contracting business.

CIVILS

William J. Rheingans, c '20, who is in the hydraulic department of Allis-Chalmers Co., has been making some commercial tests for the company at Worcester, Mass. Bill writes an interesting letter. For one thing, he sends word that the seniors may look forward to spring and job hunting with a little more hope in their hearts. Business is picking up, says Bill. "The change is slow but steady and promises for next spring are mighty good."

Professor Rood's article on the slide rule in the November number comes in for some favorable comment. "The article in the last number of the ENGINEER on decimal determination on a slide rule came at a very opportune time for me. I was working on some formulas for the discharge of air through an orifice, and the equations involved complicated decimal points. I remembered in a sort of hazy way about plus and minus signs on the slide rule, but not being sure, I worked with the approximate method. Then when I used Mr. Rood's system the entire work was very simple and accurate. The principle is not new but the method of applying it is a very good idea and works out wonderfully in practice. I was sort of disappointed in not finding a similar quick and accurate method of obtaining the square roots and cube roots of decimal numbers on the slide rule. There is a chance for some bright student to work out a rule that is easily remembered." His November copy, he says, is making the rounds of the office.

L. H. Doolittle, c '15, is assistant to the Valuation Engineer, United Railways Co., St. Louis, Mo.

N. K. Fedderson, c '21, and **Albert Birch**, c '11, were guests at a recent U. W. banquet held in Fargo, N. D.

Glen Gustin, c '21, is located at 337 S. Broadway St., Green Bay.

H. F. Janda, c '16, is an associate professor in highway engineering, and lives at Chapel Hill, N. C.

F. M. Kennedy, c '98, is commander at Scott Field, Belleville, Ill.

Andrew Ludberg, c '11, is associate professor of engineering at Idaho University, Moscow.

Harry L. McDonald, c '04, business manager of the 1904 Badger, has resigned from the U. S. Geological Survey and taken a homestead on the "Spotted Tail", ten miles north of Mitchell, Nebraska. He sends an unusual Christmas greeting—a card that shows a view of Harry himself and of "The Shack on the Lone Prair-ee". It's a nice looking "shack" with a comfortable motor car in front of it. We wish him much luck in his venture.

W. C. McNown, c '03, is professor of highway engineering at Kansas University.

E. A. Moritz, c '04, CE '05, has opened a consulting practice in irrigation engineering at Effingham, Ill.

Walter Nathan, c '18, is working in the City Engineer's office, Milwaukee.

M. C. Neel, c '20, has taken a position in the bridge department of the North Carolina State Highway Commission, at Raleigh, N. C. **P. K. Schuyler**, c '21, is in the same office.

Eugene Noyes, c '13, was elected vice-president of the Akron, Ohio, branch of the U. W. Alumni Club, at a recent meeting.

L. F. Reuter, c '15, is dealing in automobiles in Milwaukee. His address is 100 North Avenue.

E. D. Steinhagen, c '11, is Alumni Secretary for the Class of 1911. His address is 721 Fifty-First St., Milwaukee.

J. H. Waite, c '10, lives at 210 Laflin Ave., Waukesha, Wis.

Clarence F. Watson, c '10, is confined at the River Pines Sanitarium, Stevens Point, Wisconsin. He was acting as Assistant Engineer at the Nekoosa Edwards Paper Company when he was forced to leave.

H. W. Wesle, c '15, is with the Milwaukee branch of the University Extension Division.

A. M. Wolf, c '09, CE '13, is president of Wolf, Sexton, Harpor & Trueax, Inc., engineers and architects, Chicago, Ill.

ELECTRICALS

E. R. Adlington, e '15, is lieutenant in the army, and is located at Camp Jessup, Ga.

R. W. Brewer, e '21, and **Clemens Kavelage**, e '20, are with the Mechanical Appliance Co., Milwaukee. Kavelage is sales engineer for the company and may be addressed at 305 Prospect Ave.

John Cadby, e '03, EE '07, executive manager of the Wisconsin Electrical Association, urges better lighting of streets in Wisconsin cities as the result of a lighting survey showing that the present per capita cost of illuminating cities of 10,000 or more population is from 2 to 3 cents a week.

C. E. Carter, e '04, EE '08, ME '10, is vice-president and general manager of the Danbury and Bethel Gas & Electric Co., Danbury, Conn.

B. L. Conley, e '18, is now located at 2020 E. 90th St., Cleveland, Ohio.

K. Ehrgott, e '16, who was with the A. T. & T. Company for about four years after graduating, and in the army during the war, is now Electrical Engineer for the Duparquet, Huot & Moneuse Company, 312-316 W. Ontario St., Chicago.

Howard Estberg, e '07, may be addressed at 2013 Peoples Gas Bldg., Chicago, Ill.

C. A. Keller, e '99, is an officer of the U. W. Club at Chicago.

Edwin B. Kurtz, e '17, assistant professor of electrical engineering at Iowa State College, has an article entitled "Studies in the Life of Equipment" in the December 15 issue of Engineering News-Record.

R. C. Muir, e '05, recently acted as toastmaster at a Tau Beta Pi banquet and initiation conducted by the Schenectady Alumni Association in the Mohawk Golf Club, Schenectady, N. Y. Other Wisconsin men who were there were, **R. T. Wagner**, e '05, **C. B. Bradish**, e '12, **C. C. Dodge**, e '17, **G. B. Warren**, m '19, **W. E. Blowney**, e '20, **W. A. Kates**, e '21, **H. D. Taylor**, m '21.

M. N. Murphy, e '01, is an electrical engineer with J. Livingston & Co., Chicago, Ill.

D. W. Nethercutt, e '17, is employed with the Henry L. Doherty Co., Mansfield, Ohio.

Arthur Pergande, e '10, lives at 48 Makin St., Pawtucket, R. I.

Louis Reinhard, e '07, is organizing the Class of 1907 for a reunion at Madison in June. He is located in Milwaukee.

J. T. Welsh, e '10, is with the Emergency Fleet Corporation, Schenectady, N. Y.

E. M. Wise, e '19, is with the Wadsworth Watchcase Company, Dayton, Ohio.

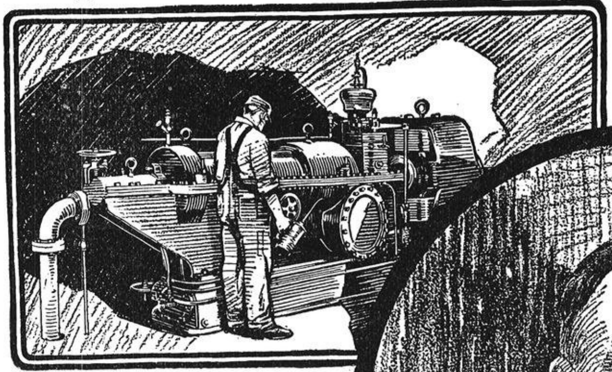
Raymond Wood, e '17, may be addressed at 1108 Massasoit Ave., Chicago, Ill.

MECHANICALS

R. W. Baily, m '07, ME '10, may be reached at Apartado 5034, Mexico, D. F. Mexico.

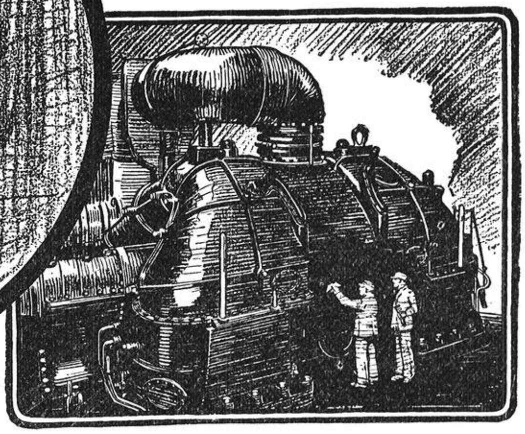
A. G. Elsby, m '15, sales engineer, may be reached at 96 Meredith St., Milwaukee.

Arthur O. Gardener, ex m '20, visited the college recently. He is teaching manual training at the Niagara High School, Niagara, Wis., and is married.



1898, 300 kv-a. Unit

1921, 70,000 kv-a. Unit



Beginning with what would now be called the tiniest sort of a unit, a turbine which had a normal rating of 400 hp. at 3600 rpm., Westinghouse has developed turbine construction to a point where three cylinder, two stage, turbines are now in service developing 100,000 hp. And a most significant fact about this development is that practically every step in this progress has been a step forward.

Francis Hodgkinson

DURING the last twenty-five years power generation practice has been revolutionized. The steam turbine has definitely displaced the reciprocating engine as the standard prime mover in large generating equipments. And Francis Hodgkinson has had more to do with this achievement than any other one individual.

Mr. Hodgkinson came to this country along with the Westinghouse Licenses under the Parsons patents, in 1896, upon the recommendation of the inventor himself. Since that time practically every commercial steam turbine Westinghouse has built has been designed and built by him and his able associates.

In this quarter-century of steam-turbine development inventive genius has been paralleled throughout by practical level-headedness. There are few cases in engineering history where the record is writ as clearly and impressively as this. There can be nothing but credit for the engineer who puts his errors underfoot and rises upon them, and most of the world's greatest achievements have been so reached. The World also honors progress that is surefooted and far-visioned, such as the development of steam turbines under Mr. Hodgkinson's direction.

Many inventions of tremendous value in steam turbine practice have been devised and perfected by him and his co-workers. Among the more important of these are the construction, in 1907, of the first low-pressure turbine to be built in America, and in 1911, of the first Bleeder type of turbine; the perfection, in company with H. E. Longwell, of the water-seal gland; a balancing machine for turbine rotors that is almost superhumanly sensitive; a trouble-proof method of supporting turbine cylinders; and a very superior process for affixing turbine blades to rotor and cylinder.

One of the fundamental Westinghouse policies is insistence upon the uttermost in engineering. The observance of this policy in form and in spirit has provided genuine opportunities for many men of remarkable engineering gifts, one of the most notable of whom is the man whose name appears as the title of this article, Francis Hodgkinson.

Westinghouse

WESTINGHOUSE ELECTRIC

A. P. Gerhardt, m '21, may be addressed at 3210 Arthington St., Chicago.

F. S. Hays, m '21, sends Christmas greetings from Warsaw, Poland.

Eugene Maurer, m '20, is with the New York Branch of the Lyon Metallic Co.

Lewis Moore, m '00, CE '06, is a consulting engineer, specializing in structural bridge work and foundations, at 73 Tremont St., Boston, Mass.

George Newton, m '07, lives in Iron Mountain, Michigan.

E. S. Prince, m '20, has been engaged in research work on enamels for metallic surfaces with the Coonley Mfg. Co., Cicero, Ill.

H. C. Prochazka, m '12, was burned to death in a gas plant accident at St. Louis, Dec. 6.

J. T. Strate, m '21, is assistant engineer with the Commonwealth Edison Co., Chicago, Ill.

E. F. Week, m '12, has moved from Cincinnati, Ohio, to 420 Hill Lane, Oakland, California.

CHEMICALS

Robert A. Baxter, ch '20, has removed from Long Branch, N. J., to 3511 Morrell, Kansas City, Mo.

Stacy L. Brown, ch ex '18, is now in the Cottage Sanatarium, Silver City, New Mexico. He contracted tuberculosis while over seas and is recovering slowly. A letter to him will help.

J. M. Gillett, ch '15, was elected president of the U. W. Alumni Club, at a recent meeting of that organization at the University Club, Akron, Ohio.

P. D. Holmes, ch '20, has moved from 24 Olcott St., Fond du Lac, Wis., to the Central Y. M. C. A., Minneapolis, Minn.

Louis Loeb, ch '15, lives in Austin, Texas.

Dr. Charles A. Mann, ch '09, is Advisor of the Association of Engineering Students that publishes the Minnesota Techno-Log.

A. G. Schutte, ch '20, science instructor, may be addressed at Box 172, Devils Lake, N. D.

MINERS

Franklin Pardee, min '15, is located at Crystal Falls, Mich., as engineer at the Hollister Mines, for the Hanna Furnace Company.

D. V. Slaker, min '20, factory manager, may be reached at 2964 N. Talbott, Indianapolis, Ind.

MARRIAGES

Mrs. Fern Kuhlman and **Edward P. Gleason**, X m '10, August 15, 1921. Gleason is Chief Engineer for the Nekoosa Edwards Paper Company.

Belle Seaver Howard and **Samuel R. Hatch**, c '07, December 25, 1921. Sam is doing research work with the T. M. E. R. & L. Company of Milwaukee.

Miss Mina Jorgenson and **Horace P. Palmatier**, e '12, June 9, 1920. Palmatier is Electrical Engineer for the Nekoosa Edwards Paper Company.

BIRTHS

To Mr. and Mrs. **N. M. Isabella**, c '14, 121 S. Hamilton St., Madison, a son, November 24, 1921.

To Mr. and Mrs. **J. R. Swetting**, m '16, a daughter, Margaret Anne, November 19, 1921.

To Mr. and Mrs. **J. B. Wilkinson**, m '16, ME '17, a daughter, Jane.

DEATHS

Walter Richards, '93, electrical expert of Milwaukee, died on November 24, 1921, after an illness of a year's duration. He had attained a state-wide reputation in his profession.

THOMAS EDDIE,— CONDUIT SNAKE

(Continued from page 70)

that he must act at once. If he turned to either the right or the left, down either branch, he would drag four wires down one circuit, and by the time two of them were pulled out, and hitched to him, and he wired the other circuit, the time would be exceeded, and I would have lost the penalty, which I could ill afford.

"Son, right there that snake determined on a plan of action, and carries it out, which for devoted self-sacrifice has never been equaled. He bisects himself on the altar of friendship, as you might say. Dashing himself against the partition between the two branch runs, he splits longitudinally, one half going down one branch, and one half down the other. As I arrives at the top floor. the two halves of his body are just emerging from the two outlet boxes, to drop with a pair of pathetic flops on the floor. There they layed; on one side of the room one half of him coiled and uncoiled in its death agonies, while the rapidly glazing eye that went with that half looked a loving good-bye at me. On the other side of the room, the other half coiled and quivered in unison, and that eye also was turned to me, every whit as loving as the first. Son, it was a sight I never can forget; no sir, never."

Here the old engineer stopped and blew his nose loudly.

"I immediately leaped over and gathered up his pieces, and fastened him in his original form with tape. I had a desperate hope that he might grow together again, and be saved to me. But the hope was vain. Thomas had a magnificent constitution and by-laws, but this last was more than he could stand. He expired in my arms—at least, about twenty per cent of him expired in my arms, the rest expiring on the floor.

"We buried him in a section of conduit, with a cap on each end, and I am not ashamed to admit that I shed quite a few tears on his grave. Elmer was not present at the funeral, he having disappeared right after I came up stairs, and discovered what he, in his duplicity, had done. I never saw him again; and it's a right good thing for Elmer that I didn't!"

Here the old engineer champed his pipe stem, and glared so fiercely at the young fireman that an onlooker might have imagined that the young fireman was the perfidious Elmer. Then the old engineer's eye softened.

"Son," he said gently, "folks talk a lot of the faithfulness of dogs, and horses, and such like. But I never heard of one yet that committed suicide for its master. And for down-right devotion ,unwavering love, and unselfish self-sacrifice, I'm here to state—and I'll risk a bet on it—that my Thomas Alva Edison snake leads all the rest!"

CAMPUS NOTES

R. B. Bohman

This Madison region sure is a cold one. Up in our "Alley", where we do most of our work, our fire-place has consumed our dwindling supply of kindling wood, and we have been forced to start the new year by placing its greedy maw on a strict diet of Saturday Evening Posts. Sort of a Literary Digest, how?

What with Shopping Week, Go-To-The-Theatre Week, Charity Week, Ride-On-The-Trolley Week, Roll-Your-Own Week, Say-It-With-Flowers Week, and a few others, we Engineers still have a few choice weeks left, which are unmarred save for the daily and nightly routine of school work. Make your reservations early.

IGNORANT THOUGH MARRIED

Mr. Beebe was explaining to a young lady in his Sunday school class what a pretty wedding gift the class had presented to Mr. Stivers. "What was this pretty gift?" the yound lady asked. And Mr. Beebe answered glibly, "Why, it's a beautiful silver-plated camisole."

THE ANNUAL CHRISTMAS EXCHANGE CLINIC

First Unknown: "Why don't you use your head when you buy your girl a Christmas present?"

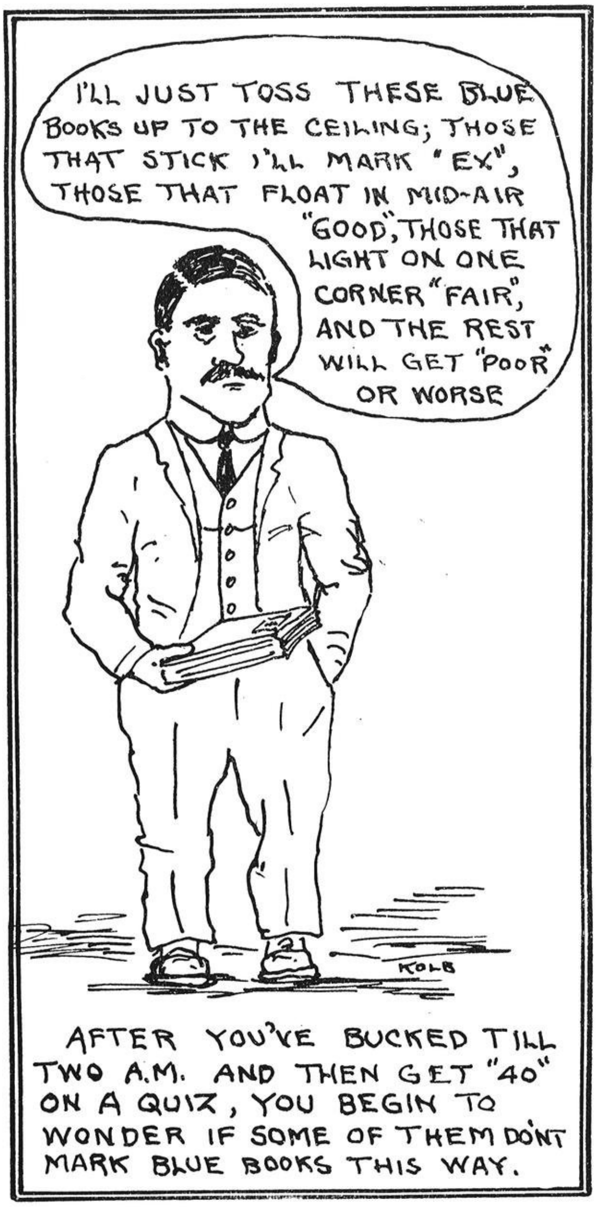
Second Unknown: "Aw Gwan! I gave her an ivory set last Christmas".

A CANDY CANE

In Leo's window, on Park street, was an immense candy cane, which was offered to the person who could estimate its weight. A group of civils surveyed that cane with transit, clinometer, hygrometer, and speedometer. They determined its altitude, its periphery, its azimuth, and its perihelion. They bought a little candy cane and tested its density, its refraction, its polarity, and its moment of inertia. Then they tabulated results. Eight slip sticks were on the job at once with streams of djer kiss playing on them to keep them cool, fourteen 3-H pencils were reduced to stubs and two pounds of rubber erasers were sent to the scrap heap. The result—their scientific estimate—they bore proudly to Leo and deposited with the guesses of the rabble. The winner? Oh, she was a home-ec who just looked at the cane and "guessed" it weighed about so much.

Instructor Mackey, of drawing department fame, summarizes his financial status as follows, "Automobile? Why, I can't even afford to pay for the smell of one!"

The campus Bosco still manages to cavort about at frequent intervals on three casters, holding the fourth hoof apparently in reserve. Oh well, three points determine a plane, anyway.



THE ELECTRICAL SHOW

Work on the Electrical Show, to be held in the early part of the new semester, is progressing steadily, and all men signed up for work in any of the exhibits are urged to devote as much of their spare time as possible toward the building of their exhibits. Places are still available for those men who have not entered their names with

the show committee. Further announcements of interest to the college and of importance to those in the show will be posted from time to time as the work progresses.

Spurred by the desire to win for Wisconsin a place in college poetry,—something that our cultured friends on the Hill failed to do last year, we laid aside the slipstick and the table of logs, ran our eye over some of the verse in "Poets of the Future", and dashed off the following:

THE SURVEYOR

Chilled to the bone,
Wind buffeted,
He stands behind the transit on its tripod.

Eye, pressed to metal, strains to see
The swaying rod through shifting tree.

The telescope is out of focus.
Stiff, frozen fingers,
With painful effort, turn the screw
That clears the glass like magic.

Out springs the rod,
Beautifully red and white.
The sight is taken.
With aching claws the notes are neatly entered
In the field book.

Azimuth.

A POST-GRAD COURSE

"No, Israel," said the Edinborough Jew to the newcomer in the country," if you have come here to make money, the only thing you will make is a big mistake. But if, on the other hand, you want to complete your education, that's something else again."

Professor "Lenny" Smith confessed to his class in Pavements that he has to have chains to keep from slipping when coming out of his cellar. It's a nice new cellar with all modern improvements, we take it.

MODERN SHOP PRACTICE

Instructor (watching lathe work on cast iron): "You must get under the scale if your cutting tool is to stay sharp."

'24 Mechanical (reaching in pocket for scale): "Now how should this be done?"

FOR THE LOVE OF MICA

Willie Sliderule: "I have named one specimen of my rock collection."

Tommy Polyphase: "Whazzat?"

Willie Sliderule: "Mike A. Schist."

"Dental Engineering" is the latest. What is a dental engineer? Why he's the expert who makes the plans showing the position of the teeth before the dentist moves them, their location after moving, and the amount of pay-haul involved.

Movies of the Civils at Devil's Lake last summer were shown recently at a private exhibition. Gude turning off angles at a triangulation station, Johnson at a plane table, the welcome to the bride and groom, and the dining tent at meal time are among the scenes that were recorded.

STUDENT-FACULTY COMMITTEE

The meeting of December 8 was fully attended, only three absences being recorded. F. W. Nolte, senior electrical, was elected chairman, and G. P. Ryan, senior chemical, was elected secretary. Professor Van Hagan was announced as faculty member for the year.

Professor Bennett reported, in detail, the action of the electrical engineering faculty upon the fifteen criticisms and suggestions that had been referred to the faculty by this committee. It is expected that Professor's report will be printed in detail in another part of this issue.

The use of the type-writer in preparing laboratory reports was brought to the attention of the committee and will form the subject of discussion at a later meeting.

Mr. G. Barker, instructor in Mining, met with a mishap on December 8, when a weight which he was carrying fell, breaking the bones in his foot.

THEY AIN'T NO SUCH ANIMULE

Doc Price: "Surely you remember him. He was a law student—might fine chap."

Louie Schmidt: "That must have been before my time."

PRAECEPTOR MILITARIS

Professor Shorey had waited patiently in line at the branch post office on University Avenue, to mail some Christmas packages. Just as he reached the window, a male, of the genus *horninicuss,* pushed ahead of him. "Who's next?" asked the clerk. "I think I am," said Shorey. "For two cents I'd call you a blinkety blanked liar", said Mr. Buttinski. Shorey's mitt shot out and grabbed a big handful of overcoat, muffler, and hide just under Buttinski's chin. "Hey, what are you doing?" asked the victim. "If you try to earn that two cents, I'm throwing you out into the street", said the man of academic pursuits, "otherwise I'm just putting you where you belong, down here at the end of the line." And amid loud cheers of the populace, that's where Mr. Buttinski went,—down at the end of the line.

SOME ARE PERFECTLY IMMUNE

Professor Owen (to class in topographic engineering): "I can expose you to this stuff, but I can't make it catch."

At a meeting of the Madison Technical Club on December 5, Professor J. T. Rood, of the Department of Electrical Engineering, gave an interesting talk on "The Evolution of Electricity".

Prof. Price (at blackboard): "This is the equation expressing the mean value of the current."

Garber (enthusiastically): "I'll say it's mean."

The Student Section of the American Society of Civil Engineers held its regular initiation on December 21. G. M. Lundberg gave a talk on "The Testing of Materials for Concrete Highways."

A regular meeting of the Student Section of the American Society of Mechanical Engineers was held on January 5. F. R. Erback gave a talk on the "Battleship Construction" which furnished many interesting details of marine engineering, one of which was the fact that mechanical draft for the boilers was secured by closing the deck hatches and putting the entire boiler room under a pressure of six inches of water. W. W. Greiling, gave an interesting talk on "Jin Poles and A Frames" as applied to construction work.

A THEORY ON WOOD PRESERVATION

(Continued from page 58)

A better proof of the theory is shown by some recent work at this laboratory. In the course of another study it was necessary to extract the creosote from a few telephone poles which had seen about 20 years' service. One of these poles had checked at the ground line in such a manner as to permit the entrance of fungi, and the entire center of the pole at the ground line was completely decayed. None of the wood which contained creosote was decayed; in fact, it was very noticeable that there was a ring of from 1/4 to 1/2 inch in the untreated wood just inside the treated portion, which was in a perfectly sound condition and had been preserved in some way or other from the fungus attack, although apparently it contained no creosote. Sections of this untreated but preserved wood were taken and any portions which showed signs of containing creosote were carefully removed. The remainder of the wood was then reduced to sawdust. A portion of this was extracted in a Soxhlet extractor with water in such a way as to retain in the water any tar acids if they were present, and another portion treated in the same manner but using a means to retain tar bases if they were present. The solutions thus obtained on neutralization gave odors similar to those obtained from tar acids in the one case and tar bases on the other. A second extraction with benzol of the wood previously extracted with water gave a residue of perfectly clear rosin in which there was not the least sign of creosote odor. From this it seems very apparent that this inner ring of untreated material had been preserved by the water soluble material which came from the creosote and had diffused through the wood.

The theory assumes that the toxicity of any material which is more soluble in oil than it is in water will be less toxic on the start if oil is present than it would be in its absence. That is, if it takes 0.05% of some material to kill an organism in water alone, it might take as high as 2 per cent if the material were dissolved in oil. On the other hand, any reserve material would not be removed as rapidly by leaching in the presence of oil as in its absence. Under the same conditions the speed at which creosote will be rendered non-toxic by leaching will depend on two things: (a) the relative solubility of the toxic oils in the non-toxic oils and in water, and (b) upon the proportion of non-toxic oils present. If too little of the non-toxic oils are present, then the toxic material will be washed away very rapidly, because there would be little or no retaining action exerted by the non-toxic oils. On the other hand, if there is too large an amount of non-toxic oil, the toxic oils will be prevented from going into solution in the water in a sufficient concentration to kill the attacking organism, and consequently these oils would not act as a preservative.

The theory here proposed can be summarized as follows:

1. Any substance to be an efficient wood preservative must be soluble in water at least to the extent of producing a toxic water solution.
2. Creosote oil may be considered as consisting of two groups of compounds, one of these being sufficiently soluble in water to render it toxic, the other insoluble and hence not toxic.
3. The non-toxic oil acts as a reservoir for the toxic oils and feeds them automatically, when needed, to the moisture in the wood .
4. The difference between oil preservatives and inorganic salt preservatives as far as this theory is concerned, is in their method of retaining the reserve supply of toxic materials. Zinc chloride has no reserve supply, all the material being soluble in the usual amount of moisture present in air-dry wood. Sodium fluoride may have a reserve supply in the form of solid crystals due to the use of a saturated solution in treatment. Creosote oil may have a considerable reserve supply stored in the oil itself, this supply being fed to the wood as it is needed.

OPPORTUNITIES FOR ENGINEERS IN FOREIGN COUNTRIES

(Continued from page 67)

What has been said of South America also holds true of Central America and Mexico. With the coming of peace in Mexico, it appears fairly certain that there will be an industrial revival. Here again the necessity of getting capital to finance the enterprises must be satisfied before engineering opportunities will be created.

Farther away from home, Spain, after long lying dormant, has awakened industrially and is calling for help. Her rich mineral resources and cheap labor supply are the foundations on which she places her hopes. English engineers have been active in Spain even during the war; and it seems improbable that Spain will offer a great field for American engineers.

The Balkans, provided they can ever settle down to peace, offer greater opportunities; but again the Europeans have the advantage. The one asset the American engineer has is the esteem in which Americans are held by the whole world. The Balkan countries have suffered greatly from the incessant warfare and sorely need new railroads, roads, and bridges. There are hardly any harbor facilities worth mentioning. The oil fields destroyed during war must be rebuilt. Here the American oil engineers, leaders in their science, have a real chance. Americans haven't realized the possibilities in the Balkans, but European countries sent their representatives to these countries nearly before the ink was dry on armistice declarations.

Russia is the great prize for which all the nations are striving. Conditions look more promising now that the Bolsheviki have turned their attention to peaceful pursuits. They have started on a gigantic program of the electrification of all the industrial districts. Extensive preparatory work has already been undertaken but dearth of machinery is holding back this ambitious plan to quite an extent. Work is also being done on the railroads and canals, the object being to correlate the two.

Whether Russia needs technically trained men is doubtful, for it has some highly trained engineers. Our opportunity is to sell the Russians finished material. Before the war the Germans had the advantage, not only on account of their proximity but because the Russian engineers, being trained in Germany, favored everything German. Russia is too rich, though, to let the Germans have a free hand. Previous to 1914 American railway engineers had wedged their way into Russia due to their superior ability. With some effort Americans can repeat this same feat. The insecurity of the government is the disheartening feature. How long a government can last that has such freak notions as furnishing free electricity to its people is the question that must be answered before foreign countries will be induced to help develop Russian resources.

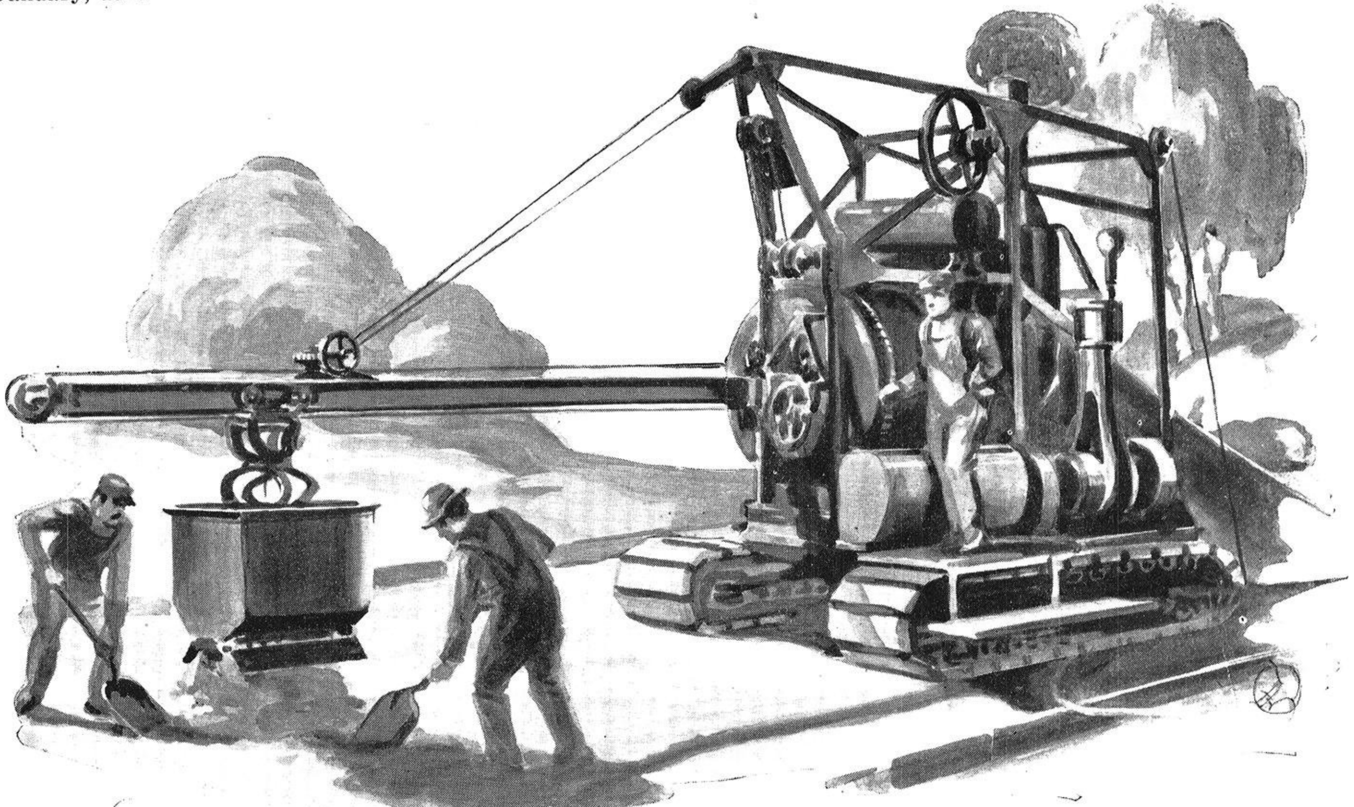
There still remains Siberia and China as fields for exploitation. Both countries have and are in the lime light, so more or less is known of their economic conditions. Japan, playing the same role as its ally, "whole hog or none", is trying to clinch its hold over these countries; but the other nations of the world are not in the mood to countenance this act. Both China and Siberia are virgin lands. Their mineral resources hold a wealth that is worth fighting for, as the bitter struggle for control over these countries shows. China is an especially favorable field for exploitation by foreigners, for the natives are not equal to the task. The backwardness of China is shown clearly by the railroad mileage, the barometer of industrial progress. The total mileage is about seven thousand miles, although the country is about one and a half times as large as the United States. From an attitude of extreme hate for the "foreign devils" the Chinese have come to welcome foreign help in developing their country.

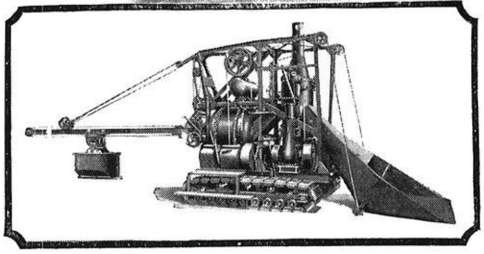
In all these undeveloped regions the engineer cannot play a lone hand. He must have the financial support, for lack of capital is the main obstacle to progress in a country. Thus it seems as if the American engineer with the enormous wealth of his country behind him has the advantage over all others. He has the advantage of being the most respected man in the world. It remains to be seen whether America will take advantage of her great opportunities. The rewards that can be obtained from the mineral resources constitute one of the strongest factors in the development of a new country. It is no wonder then that in these new foreign fields there is usually a demand for mining engineers. The civil engineer, as constructor of transportation systems, builder of bridges and developer of water power plays an equally important role. In fact a good share of his work lies in new and undeveloped countries. With the ever-increasing use of electricity as motive power the electrical engineer is beginning to have more foreign opportunities.

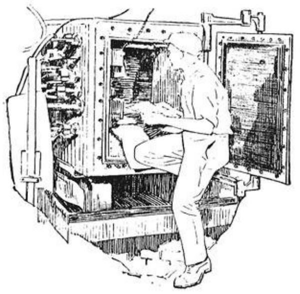
The work of the mechanical, chemical, and other engineers centers more around the industrial regions. These engineers are directly benefited by the development of a new country, it being unable to make its own manufactured articles is obliged to import them from the older countries. Lately, though, a demand for even these engineers to enter foreign service as sales agents of highly technical products has developed. It has been found that a man who understands what he is selling is more effective in getting sales, especially in foreign countries, than a purely commercial man.

A new field for engineers, though quite limited in extent, has been opened by the United States in its consular service. The government has learned through costly experience that in order to get reports of any great value on engineering subjects, technically trained men are required. The result has been the appointment of engineers as assistants to the commercial attaches in foreign cities where engineering interests are of prime importance. Usually though, these appointees are men of considerable experience. Though only a limited number of men are required in this service, positions are open frequently, for the capable men leave the government service and go into the service of some private company in the same country at a higher salary.

Before any engineer goes into foreign service he does well in considering the matter very carefully. On the one side are the possibilities of getting a large reward, the chances of seeing the world, and the opportunity of broadening one's vision. These benefits, however, must be paid for the work is more hazardous and dangerous. The practical experience usually does not help him much in his own country where conditions are entirely different. He is an exile and when he returns from abroad he will find that friends and relatives have become almost strangers. Most likely one must begin all over again when he comes back home. Unless he intends permanently to stay in a foreign country it is well for the engineer to consider whether foreign opportunities are really desirable opportunities.







What Is a Vacuum Furnace?

IN an ordinary furnace materials burn or combine with the oxygen of the air. Melt zinc, cadmium, or lead in an ordinary furnace and a scum of "dross" appears, an impurity formed by the oxygen. You see it in the lead pots that plumbers use.

In a vacuum furnace, on the contrary, the air is pumped out so that the heated object cannot combine with oxygen. Therefore in the vacuum furnace impurities are not formed.

Clearly, the chemical processes that take place in the two types are different, and the difference is important. Copper, for instance, if impure, loses in electrical conductivity. Vacuum-furnace copper is pure.

So the vacuum furnace has opened up a whole new world of chemical investigation. The Research Laboratories of the General Electric Company have been exploring this new world solely to find out the possibilities under a new series of conditions.

Yet there have followed practical results highly important to industry. The absence of oxidation, for instance, has enabled chemists to combine metals to form new alloys heretofore impossible. Indeed, the vacuum furnace has stimulated the study of metallurgical processes and has become indispensable to chemists responsible for production of metals in quantities.

And this is the result of scientific research.

Discover new facts, add to the sum total of human knowledge, and sooner or later, in many unexpected ways, practical results will follow.

General Electric Company

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