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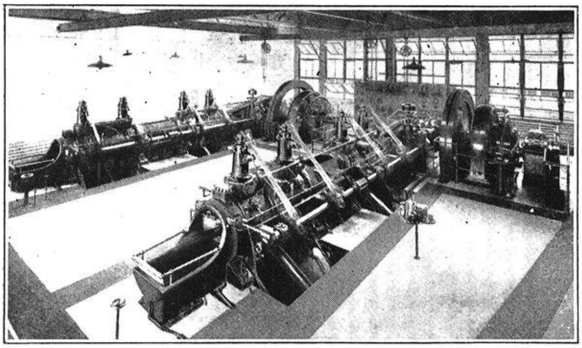
The Wisconsin Engineer

Vol. 19 OCTOBER, 1914 No. 1



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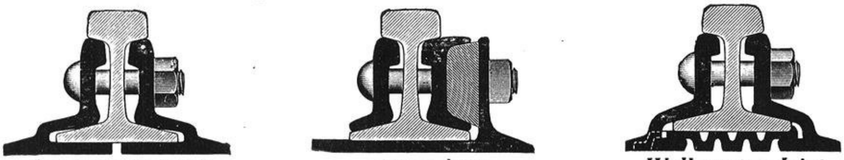

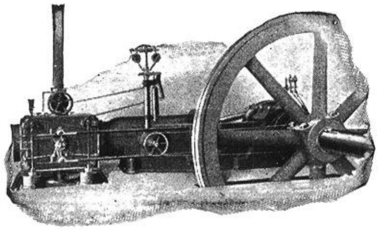

The Wisconsin Engineer

VOL. XIX OCTOBER, 1914 NO. 1

A FOREWORD

At the opening of another year I have been asked to extend a word of greeting to the readers of The Wisconsin Engineer, and more particularly to those who are yet students at the University.

It occurs to me to say a few words about the much discussed question of "outside interests." Much has been said of late about these outside interests, their great number and extent, and the manner in which they interfere with the regular work of the student, sometimes with disastrous result. To the earnest student (and this describes the typical engineer) the attitude which he shall take towards this matter is of very considerable importance.

I think he may be helped somewhat by having his attention called to the fact that outside interests do not disappear on graduation. They will continue to be present and will demand a large amount of consideration in his professional life. The successful man almost invariably becomes connected with many outside affairs that call for time and energy, and this demand is likely to increase as the years go by. The engineers' clubs and professional societies, the social club, church, business enterprices, public duties, and family cares and respon-

sibilities are things that gradually develop and load up the busy man to an almost unlimited extent. And yet all these things have a place and every strong man should do his share, especially in those things which he can do well.

But successful men whom we find active in general affairs are not successful because of their outside interests. They are successful FIRST in their regular daily business. We can scarcely conceive of a successful young engineer who would complain to his chief that he was prevented from performing certain assigned duties or delayed in getting in an important report because of any such outside matters. The proper attitude in professional life seems perfectly clear and it is also clear that any other attitude is fatal to success.

I suggest that at the beginning of a new year, the student who is confronted with the vexing question of "outside interest" try to construct in his mind a picture of himself as he hopes to be some years hence and then decide how he can make his college years a training period in the broadest and best sense of the term.

Cordially,

F. E. TURNEAURE, *Dean.*

THE THEORY OF ARMATURE REACTION IN ALTERNATORS

ROBERT C. DISQUE, '08.

Ass't Prof. of Electrical Engineering, U. W.

In spite of the large amount of literature in existence on armature reaction in alternators, one has great difficulty in finding a simple explanation of the phenomena that occur in an alternator under load. It is, therefore, the purpose of this article to reduce the theory of armature reaction to its simplest form.

It will be first assumed that both the generated voltage and armature current are sine waves. Since alternators are designed

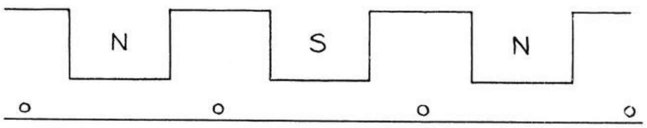

FIG. 1. DEVELOPMENT OF ARMATURE AND POLES.

to yield sine waves so far as possible, the assumption is not very far from the fact with respect to modern machines. Moreover the subject of non-sine waves can be studied most easily on the basis of the sine components. It will also be assumed that the reactive flux due to the armature current is distributed over the surface of the armature in the form of a sine wave. This assumption is of course farther from the fact than the first. It means that the armature coils are supposed to be always so distributed as to cause the armature flux to take a sine form distribution. This assumption is obviously somewhat far fetched; but here again the study of any irregular distribution will necessarily be based on the development of the fundamental sine form. It thus becomes necessary to establish first the principles relating to pure sine waves.

We shall consider first that the current is in phase with the voltage. In Fig. 1, suppose that the armature is moving toward the right and carrying an alternating current in phase with the generated voltage. At the instant shown, the generated voltage is zero and so the current is also zero. As the armature moves toward the right its instantaneous reactive magnetic effect on the pole changes for two reasons, viz (1) the current within the armature coil changes, and (2) the position of the coil in relation to the pole changes. It is evident, therefore, that the magnetic effect of the armature current is a double function of time. In other words, if the coil were to stand still in the position shown carrying a sine wave of alternating current, the reactive effect on the pole would be a simple function of time; and if the coil were moving but carrying a constant current the effect on the pole would again be a periodic function of time—a sine wave if we assume that the magnetism of the armature has the sine form of distribution. But both effects, that due to change of current and that due to change in coil position, are simultaneously present, and so the function is a double one. We shall next determine the nature of this double function of time.

Let us first confine our attention to the pole axis, i. e. the axis of direct magnetization, and consider the periodic effect of armature on that axis. If the current remained constant, while the coil was moving across the pole, the effect of the current on the pole axis would be represented by a cosine function, since at time zero—the instant shown—the effect is maximum. But the current varies according to the sine function; at any given position of the coil, therefore, the value of the current, which follows the sine wave, must first be taken into account, and this value then multiplied by the cosine of the angle through which the coil has moved. In other words the combined function is represented by

$$M \sin wt \cos wt,$$

where M is some constant maximum value and w the angular velocity. This is the product of two waves, which are displaced from each other by 90°. It may be written

$$\tfrac{1}{2} M \sin 2 wt$$

This is a function of double frequency, whose average value can easily be shown to be zero. When the current is in phase with the voltage, then the effect on the axis of the pole—the demagnetizing effect—is a function of double frequency, whose average value is zero. The two component functions, as well as the resultant, are shown in Figure 2.

The effect on the cross magnetizing axis—that midway between the poles—can be studied in a similar way. With the current in phase with the voltage as before, the magnetic effect of the armature coil on the cross magnetizing axis at time zero is zero, while the value of the current is zero as before. The magnetic effect on that axis so far as the mechanical position of the

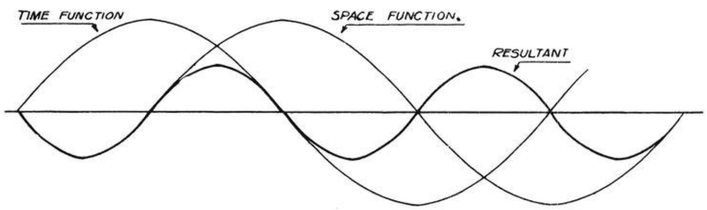

FIG. 2. DEMAGNETIZATION WHEN THE CURRENT AND VOLTAGE ARE IN PHASE.

coil is concerned is, therefore, a sine function. The variation of the current with the time follows the sine, and so the combined function can be represented by

$$M_x \sin^2 wt$$

This function is again one of double frequency, but it never falls below the zero axis. Its average value can easily be shown to be

$$\frac{1}{2} M_x$$

The second principle is, then, that when the current is in phase with the voltage, the cross magnetizing effect of the armature current is one of double frequency, with a finite average value. Its graphical representation is given in Figure 3.

Both effects explained above have great importance. Although the demagnetizing effect has an average value of zero, its double frequency character introduces variations of the field magnetism of double frequency, and this variation in turn introduces harmonics into the voltage wave. The second effect results, obviously, in a permanent distortion of the magnetic field by strengthening the trailing pole tip and weakening the leading pole tip, thus shifting the field in the direction of rotation. Since the cross magnetization is a phenomena of double frequency, it also has the effect of introducing periodic variations into the field magnetism and harmonics into the voltage wave.

We next take up the condition when the current is lagging behind the voltage by 90°. At the instant shown in Figure 1, the current will have its maximum value in the direction it

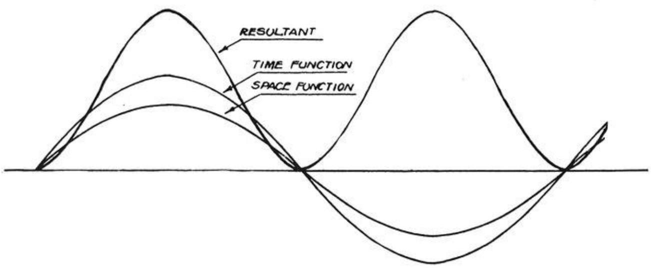

FIG.3. CROSS MAGNETIZATION WHEN CURRENT AND VOLTAGE ARE IN PHASE.

would have directly under the pole, if it were in phase with the voltage. Consider the effect on the main pole axis. At time zero the current has its maximum value; it therefore follows the cosine function. At the same instant the magnetizing effect on the main axis due to the position of the coil is maximum and hence it also follows the cosine function. The resultant function is therefore of the following form:

$$M_d \cos^2 wt$$

This function is of precisely the same form as that found for the effect of the inphase current on the cross magnetizing axis. It is a function of double frequency whose average value is

$$\frac{1}{2} M_d$$

If the magnetizing effect is followed over a complete cycle it will be found that it is at every instant opposed to the magnetization of the main pole. When the current lags behind the voltage by 90° it, therefore, introduces a magnetic variation of double frequency, which acts at every instant to demagnetize the poles, and which has an average finite value.

Consider, finally, the effect of a 90° lag on the cross magnetizing axis. At true zero the current is maximum as before, following the cosine function. The effect due to the mechanical position of the coil is, however, zero at time zero, since the axis of the armature is 90° away from the cross magnetizing axis. This accordingly follows the sine function. The resultant is

$$M_x \cos wt \sin wt$$

This yields again a function of double frequency with an average value of zero. When the current lags by 90°, therefore, the magnetic reaction on the cross magnetizing axis is one of double frequency, with an average value of zero.

When the current leads the voltage by 90°, it can be shown in a quite similar fashion that it exerts a positive magnetizing effect on each pole with a double frequency with a finite average value, and a cross magnetizing effect of double frequency with an average value of zero. Unlike the lagging current, it serves to magnetize along the main axis and so to increase the magnetism of the pole pieces.

When the current is neither in phase nor out of phase by 90°, it can be resolved into components and these components treated as before. Suppose that the current lags by an angle Θ; if the voltage follows the law

$$E \sin wt$$

the current will follow the law

$$I \sin (wt - \Theta)$$

The latter expression can be written

$$I(\sin wt \cos \Theta - \cos wt \sin \Theta)$$

Here we have two components which are 90° away from each other with maximum values of $I \cos \Theta$ and $I \sin \Theta$, the former in phase with the voltage and the latter 90° behind the voltage. The component $I \cos \Theta$, being in phase with the voltage, exerts an average cross magnetizing effect proportional to

$$\tfrac{1}{2} \cos \Theta$$

and an average demagnetizing effect of zero. The component $I \sin \Theta$, being 90° out of phase with the voltage, exerts an average cross magnetizing effect of zero, and an average demagnetizing effect proportional to

$$\tfrac{1}{2} \sin \Theta$$

As shown before each one of these four effects is of double frequency.

According to the foregoing explanation we can represent the physical effect of the armature reaction, when the current is in phase by actual excitation currents. Let it be imagined that a special winding separate from the ordinary exciting winding be wound on each pole and that it carry alternating current whose frequency is double that of the machine voltage. If this alternating current be imagined to be in the correct phase position so as to produce a periodic magnetization similar to that shown in Fig. 2, it will produce the same effect as a current in the armature in phase with the voltage, for it will have alternate positive and negative values. It will cause a periodic magnetization of double frequency with an average value of zero. Further, the cross magnetizing effect of the inphase current can be represented by inter-poles midway between the main poles provided with exciting windings. Let these windings be imagined to be supplied with a pulsating current of double frequency, instead of an alternating current,—one that pulsates periodically between a zero and a maximum. The magnetic effect of this current if it be imagined to be in proper phase position will simulate the cross magnetization of the inphase component.

To represent the effects of a current 90° out of phase with the voltage, we need only to suppose the pulsating and alternating currents of the imaginary windings described above to change places. The excitation of the inter-polar winding will be alternating of double frequency with an average value of zero; the excitation of the main winding will be a pulsating one of double frequency with a finite average value.

It remains only to refer to the constants involved in these reactions. Obviously the nature and distribution of the armature coils is of extreme importance in determining the actual reactive effect. The number of turns per coil, the width of the coil, the width of the flux entering the armature, and the pole pitch are the dimensions that determine these constants.

A FIELD FOR ENGINEERS

F. A. DeBoos, '09.

Manager Johnson Service Company.

Every year throughout the United States, hundreds of engineering colleges are turning out graduates. Small technical schools may graduate only a dozen while the larger universities give diplomas to several hundred. Many students do not graduate, but with a partial training seek to earn their living along engineering lines. The question: "What becomes of the engineers?" is almost if not quite analogous to "What becomes of the pins?" Certainly all of these men do not remain in strictly engineering work, and the percentage which finds occupation along other lines must be very great.[1]

This constant flow of engineers from our colleges, however, has tended to flood the engineering market and has not only produced a supply of engineers greatly exceeding the demand but has also created a condition of low salaries. In many lines of engineering work, the firm or corporation employing engineers have a specific line of work. This means specialized engineering knowledge and in general these firms and corporations prefer to educate or train their own men. To a considerable extent the duties in the main become what might be termed "clerical engineering" in which one or more engineers of ability and experience direct the energies of many subordinates through the routine channels leading to the development of the firm's product. The average engineer therefore may expect a long period of routine work, not requiring much engineering ability, and a salary commensurate only with such work.

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[1] Editor's Note.—There is much difference of opinion and also uncertainty about the statistics concerning the kind of work and the salaries received by graduates from engineering schools. A summary by occupations of engineers graduated from the University of Wisconsin to 1912 shows that the following percentages are engaged in engineering work, or work which requires a training in an engineering school: Chemical Engineers, 70%; Civil Engineers, 79.4%; Electrical Engineers, 83.5%; General Engineers, 77.9%.

Many students are now entering engineering colleges. They are enrolling in the various engineering courses and in a very large percentage of the cases, have little idea of their ultimate work. In four short years the largest problem they will have to face is that of making a comfortable living. It is therefore perhaps worth while to look into the future to see what the average engineer may expect, as such a foresight may prove of value where the new student does not have a definite idea of what he ultimately desires to do.

The "Bent of the Tau Beta Pi" for January, 1913, contains an interesting article on "The Salaries of Engineers." From replies received from 522 graduates in engineering courses at Iowa State College out of a total of 943 men graduated from these courses in the years 1878 to 1910 inclusive, a curve was drawn which indicated "The average engineering graduate may reasonably expect an income of $2,000 eight years after graduation, $3,000 fifteen years after graduation and $5,000 twenty-eight years after graduation."

The following table was also given showing the results of an investigation made for the class of 1902 of the Worcester Polytechnic Institute, and is compiled from thirty-one answers sent to forty-three members of the class.

AVERAGE SALARIES EACH YEAR AFTER GRADUATION.

1	2	3	4	5	6	7	8	9	10
$763	$935	$1,075	$1,194	$1,373	$1,494	$1,664	$1,889	$2,203	$2,406

From the data presented in this article, it may be assumed that the average salary paid an engineering graduate would be about $1,500 five years after graduation; that in eight years it would reach $2,000 and in fifteen years it would approximate $3,000.

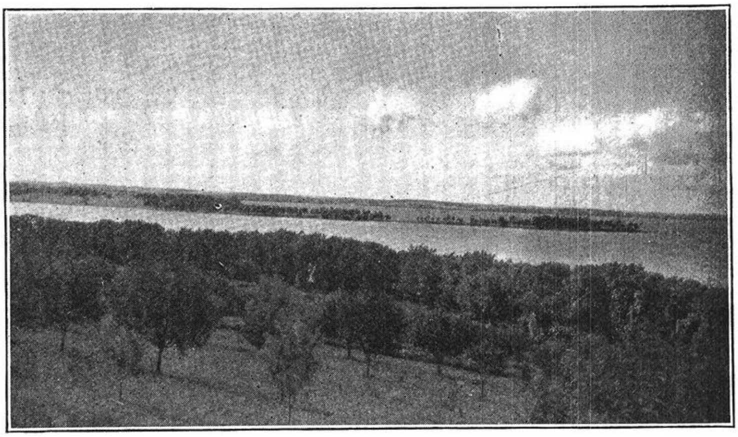
There is one field for engineers in which there are very good opportunities; where a technical education may be made a very valuable asset; where advancement is quick and certain if one is at all successful; and moreover, a field that is practically unlimited. This is the field for technical salesmen. Within the past few years engineering graduates are rapidly taking advantage of the opportunities which it offers.

We are all salesmen to a greater or less extent. The doctor, lawyer, teacher and engineer all sell their services. A manufacturer sells his product and upon his ability to successfully dispose of this product depends his commercial success. If the product is extensive it may require the services of many assistants in order that it may be correctly marketed. If the market is large branch offices may be required in different localities in charge of trained assistants. Each assistant thus becomes the personal representative of his employer, and the manufacturer's success depends more upon their ability to successfully market the product than upon any other one item. He may manufacture an article of merit; he may have so perfected his shop organization as to produce this article at a small cost in comparison to similar articles manufactured by rival concerns, but if this product is not marketed successfully the factory will be forced to shut down. The president of a large manufacturing concern sums it all up in one statement: "Give me the right salesmen and I can make a success of any legitimate enterprise." Perhaps in no other class of salaried position has the employee more opportunity to demonstrate his worth, or as much freedom to exercise his own initiative and judgment. If he is a producer he is sure to be valued proportionately.

Three large firms operating throughout the United States have in their employ about twenty engineering graduates, all of whom have been employed during the last few years. They are mostly recent graduates of the University of Wisconsin and Purdue University, having completed various engineering courses. The first of these men created a good impression for engineering graduates with the presidents of their respective concerns and as a result most of the new men who have since been employed have been college graduates. These men sell mechanical articles and hence may be termed "technical salesmen." From an investigation of the salaries paid these various men, the following facts developed: Eight of these men now hold positions either as branch or sales managers; the average salary paid at the start was $75 which was increased to $100 within one year's time. In two years they were making between $1,500 and $1,800, and in three years, from $1,800 to $2,100, which is five years in advance of the salary paid the average engineering graduate who remained in strictly engineering lines, according to the data compiled by the "Bent of the Tau Beta Pi." In addition to their salary, these men also receive all traveling expenses, and the nature of their employment demands that they patronize the best hotels and travel in such a manner as to maintain the dignity of their respective firms. There is also a probability of obtaining an interest in the business, or of their receiving a commission in addition to a regular salary, which would mean an increased revenue over their salary. Two of the twenty men are making $5,000 a year. They graduated about eight years ago. Others who have been with their firms approximately five years are receiving from $2,500 to $3,000. A couple have made even more advanced progress.

The field for technical salesmen extends to every line of industry. There has been a great change in the last few years in the selling end of most industries. The general impression seemed to be that the main essential required was an ability to "talk a man to death" with little regard to knowledge of the product. The demand is now for clean young men having a thorough knowledge of their subject. Their engineering course is a valuable asset as with this foundation they can readily pick up the essential details of the product which they are to market. Any student contemplating entering work of this sort should try and take advantage of every opportunity offered to pick up details on the ordinary methods of doing business. Clerical and stenographic work in the offices of any factory would constitute experience of the most valuable sort, as very few engineers have the ability to write a clear letter, spell correctly, nor do they possess the slightest business training. A business course should be a part of every college curriculum. Many engineers may go into other lines of work, but they all require a working knowledge of business methods.

Technical salesmen are actively engaged in furthering the progress of the world. They are the ones on the firing line and are largely responsible for the changes and advancements made in the articles they handle, since they are the connecting link between the factory and the customer. If an office building is equipped with faster and safer elevators, the public is saving many minutes and is better safe guarded. If through the salesman's efforts, a community is afforded a modern water plant, he may be the direct cause of saving the people of that community from more ills than all their doctors combined; should a fire-proof building be erected in place of an inflammable structure, it may be the direct cause of preventing a terrible catastrophe. Whenever the technical salesman is successful, it means more work for the laborer, the mechanic and the engineer, and material wealth for that community.



ELECTROLYTIC COPPER REFINING

R. S. McCaffery.

Prof. of Metallurgy.

The electrolytic refining of copper is carried on for the purpose of eliminating small quantities of impurities which are contained in the copper bars produced by the smelting of copper ores.

Copper ores of high grade are smelted directly, while low grade ores are first subjected to water concentration. The ore or concentrates are smelted in blast or reverberatory furnaces to a matte, which is an artificial sulphide of copper and iron. The slag from this smelting process is rejected, while the matte is blown to metal in bessemer converters. This metallic copper, called converter, blister, or black copper, is partially purified in a reverberatory furnace and then cast into anodes. It is these anodes which are electrically refined to remove the small quantities of impurities still remaining in the copper. The analysis of the converter anodes in Table I[1] will give an idea of the composition of the material refined.

One ampere per second deposits 0.0006589 grams of copper from cupric salts, or, approximately, one ampere deposits one ounce avoidupois per day Of the impurities present in anode copper, gold, silver, cuprous sulphide and platinum are insoluble and go into the slime which falls to the bottom of the electrolytic tank. Nickel, cobalt, iron and zinc go into solution but are not deposited on the cathode because their deposition voltage is above that of copper and the tank voltage is so regulated that they remain in solution while the copper is deposited. Lead forms a sulphate and tin a basic sulphate which are insoluble and go into the anode slime or mud, as do selenium and tellurium, while arsenic, antimony and bismuth go into the solution and may be precipitated and enter the mud as basic sulphates, or if they remain in a soluble state they may be deposited on the cathode because their electromotive force of deposition is less than

[1] W. T. Burns, The Great Falls Electrolytic Plant, Bulletin A. I. M. E. 80–2020.

that of copper, arsenic being 0.27 volts, bismuth 0.21 volts, and antimony 0.10 volts, while copper is 0.30 volts.

The technical and commercial problem in electrolytic copper refining is, then, to so select and regulate the composition of the electrolyte, the current density and the tank voltage, that a copper will be produced which will satisfy industrial requirements and the impurities from the slime and electrolyte recovered and marketed as by-products.

THE GREAT FALLS ELECTROLYTIC PLANT.

TABLE I.—*Analyses of Anodes, Electrolyte, Wire Bar and Electrolytic Slime.*

	Converter Anodes Per Cent.	Electrolyte Per Cent.	Wire Bar Per Cent.	Electrolytic Slime Per Cent.
Copper	99.1300	3.280	99.9500	43.3400
Arsenic	0 1183	0.500	0.0016	3.0300
Antimony	0.0534	0.041	0.0015	3 4600
Nickel	0.0420	0.377	0.0006	0.0800
Cobalt	0.0018	0.016	Trace	0 0060
Bismuth	0.0038	0.021	0.0004	0 1100
Iron	0.0110	0.600	0.0006	0.3640
Silver	0.1371	None	0.0030	17.1870
Gold	0.0008	None	Trace	0.1200
Selenium	0.0090	None	....	1.2000
Tellurium	0.0170	None	....	2.1000
Lead	0.0065	Trace	Trace	0.7600
Zinc	0.0035	0.418	0.0001	0.0900
Sulphur	0.2610	....	0.0025	13.2100
Oxygen	....	....	0.0350	....
Silicon	....	....	....	0.1770
Chlorine	....	0.0040	....	0.0260
Carbon	....	....	....	0.5900
Platinum	....	....	....	0.000166
Free sulphuric acid	....	13.0300	....	....
Specific gravity	....	1.220	....	....

The electrolytic refining of copper is carried on in the United States in the folowing refineries, Table II, and the capacities given are those of 1912.[2]

The multiple process is employed at all these works, except the first, which uses the series process exclusively, and the third, which employs the series process for part of its capacity. The multiple process will be described and the features which distinguish the series process afterwards pointed out.

In the multiple process, anodes of the copper to be refined are

[2] Walker, Mineral Industry, XXI—288.

suspended in a lead lined tank of the general construction shown in Figs. 1 and 2.[3] To circulate the electrolyte, the tanks are arranged in groups or "cascades," with a drop of a few inches between the tanks. The electrolyte from a storage tank enters at the top of the first tank of a cascade and is drawn from the lowest tank and returning by pumping to storage or purification.

Electrolytic Copper Refineries in the United States.

Table II

Name	Location	Capacity Lbs. per Annum
Nichols Chemical Co.	Laurel Hill, L.I.,N.Y.	330,000,000
Raritan Copper Works.	Perth Amboy, N. J.	360,000,000
Baltimore C. S. & R. Co.	Canton, Md.	312,000,000
American S. & R. Co.	Perth Amboy, N J	192,000,000
United States M. R. Co.	Chrome, N. J.	180,000,000
Balbach S. & R. Co.	Newark, N. J.	48,000,000
Anaconda C. M. Co.	Great Falls, Mont.	65,000,000
Tacoma S. Co.	Tacoma, Wash.	36,000,000
Calumet & Hecla M. Co.	Buffalo, N. Y.	55,000,000

Along the sides of the electrolytic tanks run busbars of rolled or cast copper, the anodes in contact with the busbar on one side of the tank and the cathodes which hang between the anodes, in contact with the other busbar. The anodes and cathodes in any one tank are thus arranged in multiple but the tanks are arranged one after the other in series.

The anodes of the copper to be refined are cast about three feet square and usually have cast suspension lugs from which they hang vertically from the busbars in the tank. They are corroded in from two weeks to two months, depending on their thickness and on the current density used.

The cathodes are thin plates of pure electrolytic copper, called "starting sheets," made in certain tanks "stripping tanks," set aside for this purpose. These tanks have rolled copper cathodes, the surfaces of which are covered lightly with grease and graphite, and when a sufficiently thick sheet of copper has been deposited on them the plates are drawn out and the thin starting

[3]Burns, Loc. Cit.

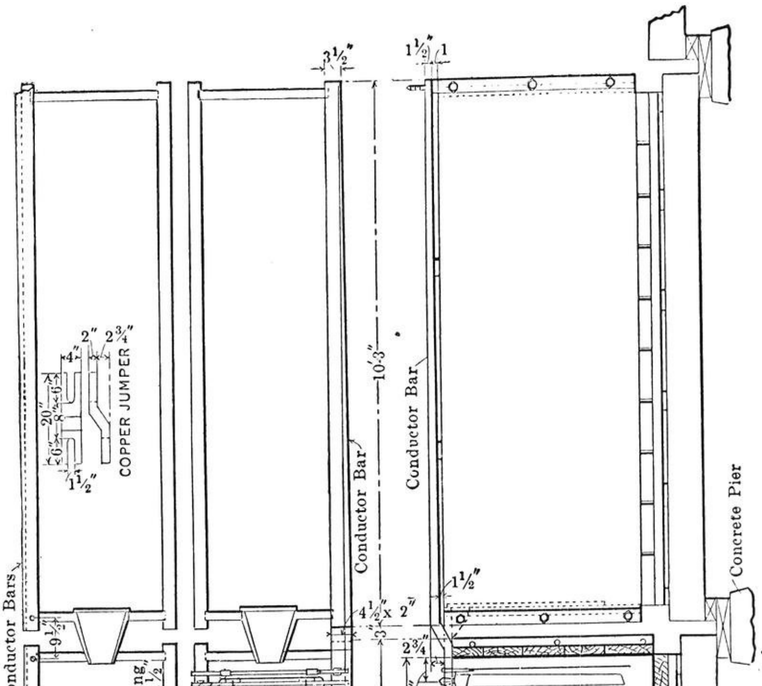


Fig. 1. *Details of Refining Tank.*

sheets are stripped off. After trimming, these are used as cathodes in the regular tanks, each sheet being hung from a copper bar extending across the tank.

The electrolyte is twelve to sixteen per cent blue vitriol ($CuSO_4+5H_2O$), with five to thirteen per cent free sulphuric

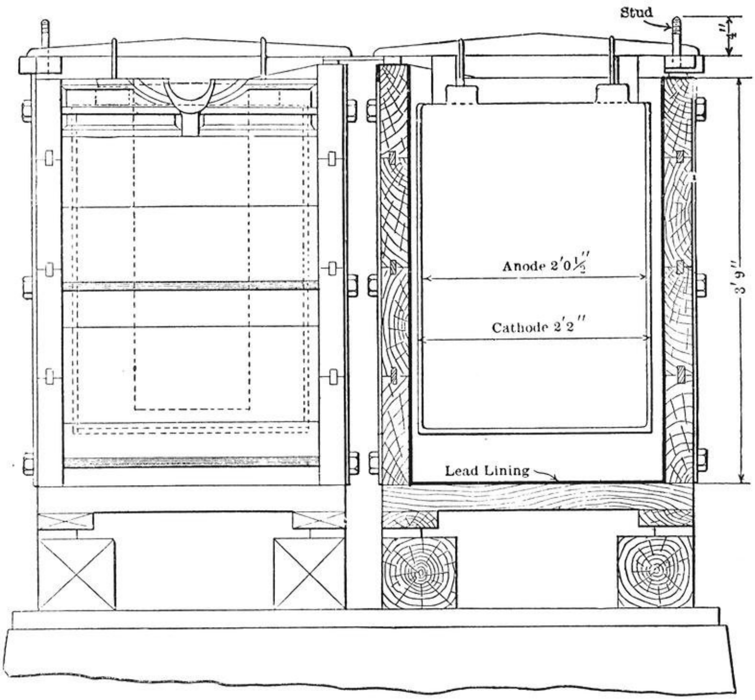


FIG. 2 —TANK DETAILS.

acid. This is circulated at the rate of three to six gallons per minute, replacing in this way the electrolyte in a tank every three hours when a current density of forty amperes per square foot of cathode is employed, and in five or six hours with a current density of ten amperes. The analysis of an electrolyte is given in the third column of Table I.

The current density employed varies from thirty-four amperes per square foot of cathode at Great Falls to twelve amperes at the Buffalo plant, and averages about twenty amperes. When the current is passed through the system the copper dissolves at the anodes and deposits on the cathodes; the insoluble impurities, gold, silver, platinum, selenium, tellurium, etc., collect as a slime or mud in the bottom of the tank along with the impurities which may be precipitated, as lead and tin, while the other impurities, arsenic, antimony, bismuth, nickel, cobalt and iron, dissolve and concentrate in the electrolyte, from which they must be removed

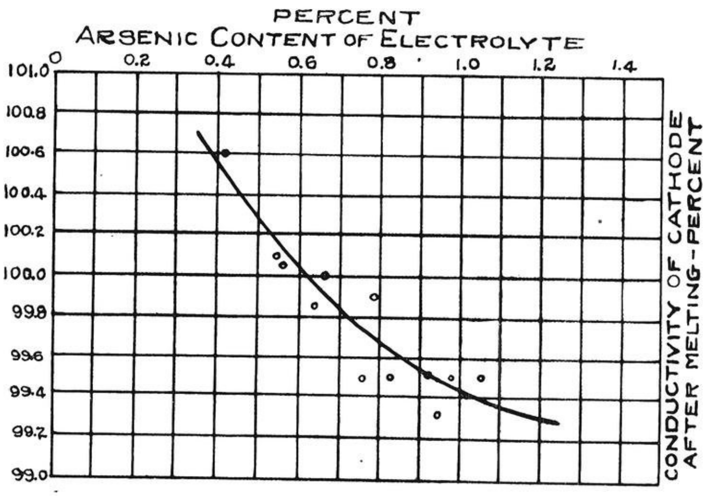


Fig. 3.

to keep the cathode deposit pure. This is done by taking continuously about two per cent of the circulating electrolyte and running it through the purifying or regenerating department. Here the electrolyte is first evaporated by steam in lead pipe coils and copper crystallized out as blue vitriol or copper sulphate: the arsenic and antimony are then removed in electolytic tanks, using insoluble anodes, and the iron, nickel, copper, bismuth, and zinc are finally extracted by crystalization and chemical treatment. The necessity for purifying the electrolyte is illustrated strikingly in Fig. 3,[4] where the effect of arsenic on the electrical conductivity of cathode copper is shown.

The slimes from the regular electrolytic tanks containing gold, silver, platinum, selenium, tellurium, etc., a typical analysis of which is given in Column 5, Table I, are washed, dried and

[4] Addick's Metallurgical & Chemical Engineering, Vol. I p. 580.

roasted and then treated in a furnace, with or without the addition of lead. This furnace produces a gold-silver bullion, called doré, which is electrolytically parted to separate the gold and silver.[5]

FLOW SHEET OF ELECTROLYTIC COPPER REFINERY

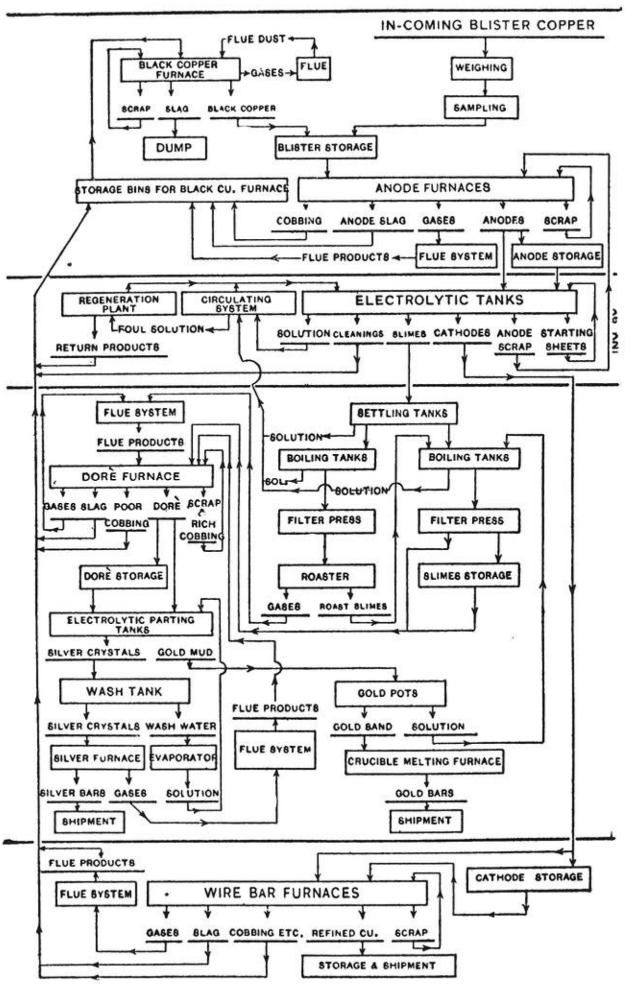


FIG. 4.

[5] For details of parting gold and silver see Durham, Electrolytic Refining at U. S. Mint, San Francisco, T. A. I. M. E. XLII–874.

The complete flow sheet of an electrolytic copper refinery is given in Fig. 4.[6]

The percentage distribution of energy at the Great Falls Refinery is,[7]—85.73 per cent in the regular tanks, 3.78 per cent in the starting sheet tanks, 4.50 per cent. in the insoluble anode tanks, and 5.99 per cent in the transmission. Table III gives an analysis of the tank resistance at the same place.

TABLE III

320 regular refining tanks, 22 anodes, 22 cathodes per tank, 90% ampere efficiency, 2 day cathodes.

	Volts per tank	Volts per 320 tanks	% of 190.40 volts
Drop between anode bus and anode...	0.044	14.08	7.40
Drop between cathode bus and cathode	0.055	17.60	9.24
Drop across electrolyte...............	0.495	158.72-	83.36

In the series process of refining, electrodes are rolled from the material to be refined and a number are placed in the tanks, which they fit closely at the sides; the end electrodes in the tanks are connected with the busbars, and one side of the electrodes becomes positively charged while the other side is negatively charged. This results in the copper being dissolved from one side of the electrodes and deposited on the adjacent side of the next electrode. This is continued till all the original material of the electrodes had been dissolved and redeposited.

In the series process the electrolyte is purified and the slimes refined the same way as in the multiple process. The latter process is more widely used and has been installed in the newer refineries. As it requires less care in manipulation, it can be used on material of a wider range in composition, and it costs slightly less than the series process.

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[6] Deacon, R. W.; Metallurgical & Chemical Engineering, May 14.
[7] Burns, Loc. Cit.

WELDING MALLEABLE CASTINGS

A PROCESS OF ACCOMPLISHING THIS WITH THE OXY-ACETYLENE TORCH

While the process of autogeneous welding is being used so successfully in all the metal trades, many unsuccessful attempts have been made to weld malleable cast iron, and to those who have experienced disappointment, an explanation of why their efforts failed, with an outline of a method by which these castings can be mended, should be of benefit.

Malleable castings are first made in the condition of hard, brittle, white cast iron and subsequently made malleable by heat treatment. The heating process which converts white cast iron to malleable iron is called annealing, and effects a chemical change in the structure by decarbonization. This decarbonization is nearly complete at the surface and penetrated in a lessening degree toward the center, giving the outside portion the texture of mild steel while the inner portion may retain, in a more or less degree, the qualities of cast iron. When this metal is remelted the carbon is dispersed, and the entire mass reverts to cast iron.

The operator who is used to welding mild steel and cast iron will recall that they are handled differently. That the method used in welding steel to steel would be useless in welding cast iron, or the methods employed with cast iron would be equally unsuccessful with steel. That is practically what he is trying to do when he undertakes to weld a malleable casting. The material is not homogeneous. The bottom portion of the welding being in cast iron, and the top portion in steel, with no definite dividing line between, it is useless to follow the method prescribed for either, and to his trouble is added the difficulty occasioned by the diffusion of the elements in the material melted from the sides of the fracture.

It follows that to successfully mend a malleable casting the process employed must not necessitate the sides of the fracture, that the welding material should fuse at a lower temperature than the casting, and that its adherence, bonding qualities, physical strength and ductility should closely resemble the original casting. After much study and experiment the Vulcan Process Company and their allied interests in Minneapolis are having considerable success in mending broken malleable castings, and a description of their methods will undoubtedly be useful to others who are employed in the metal trades.

In preparing the work for mending, the fracture is chipped away in the form of a V groove with the pointed bottom just coming to the surface on the opposite side, or, if the casting is thick and the opposite side accessible, two grooves are cut with their pointed bottoms meeting in the center. The part surrounding the fracture is then heated with an oxy-acetylene torch to a bright red, and sprinkled with Vulcan bronze flux followed by a few drops of Tobin bronze melted from the welding rod. If the bronze remains in a little globule the work is not hot enough, but if it spreads and adheres to the surface, the temperature is right, and the groove should be quickly filled. It is not advisable to keep the work hot any longer than is necessary, but to make the mend as quickly and at as low a temperature as possible. The behavior of the bronze affords a guide in regulating the temperature. This process cannot be called autogeneous welding, but a malleable casting mended in this way is practically as good as one piece. It has about the same tensile strength and ductility as the original and the process has the advantage of being very quickly performed.

—Reprinted from The Iron Age, July 16, 1914.

THE HISTORY, THEORY AND PRESENT DEVELOPMENT OF MODERN MOTION PICTURE MACHINERY

THESIS OF JOHN S. CORLEY, B. S. (MECHANICAL ENGINEERING) 1914.

Reviewed by JOHN G. D. MACK, *Professor of Machine Design.*

It is not possible to give more than a brief review of this interesting thesis on account of its length, 129 pages, in addition to an appendix giving the sources of information from which the material was obtained.

Even with this necessary length, the investigation and discussion is limited to the mechanisms for making and projecting the pictures. For example, the limit precludes any discussion of the various film devices, the perfection of lenses or the interesting combination of a moving picture machine and phonograph.

The subject is treated under the following heads:

I Foreword.
II Chapter I The History of Motion Picture Machinery.
III Chapter II An Outline of the Theory of Motion Pictures.
IV Chapter III Motion Picture Patents in the United States.
V Chapter IV A Consideration of the Patents.
VI Appendixes A. B. C.

In the Foreword, a few brief statements are given which illustrate the magnitude of the motion picture development, as follows:

The motion picture business has been variously estimated as amounting to as much as $800,000,000 per year. The investment in the motion picture business in this country alone is estimated at $225,000,000.[1]

There are produced every week one hundred photoplays, exclusive of the scientific, historical, educational, and news service subjects. A motion picture theater in Paris seats 7,000. Reproductions from a single film may be viewed by 15,000,000 peo-

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[1] In Madison, a city of 30,000 population, there are at present, August, 1914, nine permanent moving picture theaters, one giving summer exhibitions, and one under construction.—*Reviewer.*

ple in a season,—more than could be reached by a single company in twenty years with a play of extraordinary success.

CHAPTER I. HISTORY.

Motion pictures have attained a popularity in the last few years which is phenomenal. While much has been written descriptive of the reasons for their fascination, the world has never realized that this growth is the result of several decades of untiring effort on the part of many men of the greatest scientific attainments.

The idea of using separate pictures showing various stages of motion, to be shown in rapid succession, and thus give the deception of movement is very old, as illustrated by the Zoetrope or "Wheel of Life," once a famous toy, in which the successive pictures were reproduced from hand made drawings. The modern moving picture machines are based on photographic reproductions and nothing, therefore, except the general idea may be traced to the Zoetrope type.

The first photographic plates required an exposure of six hours, while the present films will give a superb negative with an exposure of less than one-thousandth of a second. While the modern motion picture machine is dependent on the film, which was brought out in the early nineties by Eastman and Walker, that subject, as already noted, is without the scope of this work.

The impetus to the search for a means of recording motion photographically was given to the scientific world by E. J. Muybridge in 1872, when he photographed the positions of a running horse by means of twenty-four cameras which were arranged to give successive exposures by the horse breaking a thread attached to each and stretched across his path.

The Edison machine was the first to be adapted to films and was exhibited at the Chicago World's Fair in 1893 as a nickel-in-the-slot peep-hole machine, timed to run about thirty seconds. Before the development of Edison's Kinetoscope, many experimenters were attempting the solution of the problem by the use of glass plates, or circular discs, which work resulted in a number of ingenious devices. These however were all swept away by the more satisfactory film.

In the first half of the 1890 decade the development was rapid. By 1895 the camera and projection apparatus had been fairly well perfected and it appears that the first public exhibition of projected pictures in this country was given in New York City in 1896; about the time of the first public exhibit in England.

CHAPTER II. THEORY.

To the casual observer, a "moving picture" seems to show actual motion. Analysis however demonstrates that the motion effect is a deception due to "visual persistence." The lagging transmission from the eye to the brain allows a slightly different position to be substituted, which deceives the eye into beliving it witnesses actual motion. During this period, the eye must not be allowed to witness the substitution, or confusion of images will result; consequently the light is excluded during the change of picture by some form of rotary shutter.

In the earlier machines the improper timing of the periods of picture and darkness caused excessive fluttering and consequent eye strain. A rate of thirty pictures per second was used in these earlier machines, but experience has shown that this can be reduced considerably with no loss in effect. The values used at present are about one twenty-fourth of a second for the picture and one thirty-second of a second for the darkness interval.

One experimenter has succeeded in shutterless projection by properly timing the picture and shifting intervals, but this method has not been adopted in practice. Neglecting the flicker due to light and darkness, or supposing it to be eliminated, another flicker effect is likely to be present due to the too rapid motion of an object which allows the eye to catch the separate motions instead of receiving the deception of continuity of motion.

CHAPTER III. PATENTS.

The author made the attempt, as he states, to brief all the United States Patents relating to motion picture machinery to February 17, 1914, within the limits already given. This was a long study and resulted in a commendable piece of work,—the investigation being carried on in the Patent Records of the Wisconsin Historical Library.

The author has briefed 479 patents, giving the salient material of each with introductory comment as follows:

"It is not to be expected that a review of this nature could possibly cover all the features of each patent, but its possible value lies in the fact that distinctive and original features are outlined in each case. Thus a reader is enabled to sort into groups those patents which he may wish to investigate in detail.

"Furthermore, it affords concrete evidence of the ingenuity of the inventors who have attacked the problem from so many angles. The solutions of these problems afford an interesting study of mechanisms, as evidenced by the wide variety of intermittent motions described and of which there appears, as yet, to be no end.

"It seems impossible to trace any definite line of development through the patents as issued, for well into the later years patents have been granted on glass disc machines which have been entirely superseded by the more practical film machines. The simple bock kinetoscope and the old *thaumatrope* are the subjects of patents granted in 1913."

The first patent briefed is No. 18,545, Nov. 3, 1857, Gordon, as follows: "An improvement in printing, which has a relation to the drawing in evenly by means of friction feed rollers, the sheet on strip intended for printing purposes, and subsequently cutting the same into desired lengths."

While the bearing of this, considered alone, on the subject is not apparent, the relation becomes evident in connection with the second briefed, No. 27,572, as showing the direction in which inventors were working at this very early stage of development.

No. 27,572, March 20, 1860, Sealey and Lee. "In this machine, plates were attached to a band run over two rollers, in such a way that one picture at a time would be revolved into the patch of light in a stereoscope."

CHAPTER IV. A BRIEF CONSIDERATION OF THE PATENTS.

The author comments as follows on some of the patents which attract special attention by reason of their novelty, peculiarity or particular merit:

"No. 93,594, August 10, 1869, claimed the use of a shutter with a revolving polygonal plate, a belt and pulleys operating both plate and shutter. This was the first claim discovered for a moving picture shutter.

"No. 212,864, March 4, 1879, was the first of a series issued to Muybridge, the pioneer whose work was noted in Chapter I.

"No. 317,049, May 5, 1885, Eastman and Walker, is for a roll holder for films which shows that these two men, at this early date, were approaching the practical film which they put on the market a few years later.

"Nos. 491,993, February 21, 1893, and 493,426, March 14, 1833, both to Thos. A. Edison are of importance as controlling the original Kinetoscope.

"No. 576,542, February 9, 1897, represents a pioneer attempt in synchronizing a moving picture machine with a phonograph.

"No. 742,643 is interesting as an atempt to allow a moving audience on a train to view 'stationary pictures'."

The above are merely illustrative of the innumerable interesting points to be found in the patent briefs.

REVIEWER'S NOTE.

The alloted space for this review prevents the giving of more complete statement of the details of the development of this mechanism which is now the basis of a business of almost incomprehensible magnitude. It is believed, however, that the review indicates the general scope of the work.

This type of library thesis the writer believes to be of great value to the engineering student, as it gives a rather intensive training in historical and library research to a degree not met by any of the regular engineering subjects. This practice is of great value in many practical problems.

A thesis of similar type on the "Telephone" by I. A. Bickelhaupt, B. S. (Mechanical Engineering) 1914, and a laboratory thesis on "The Heat Insulating Properties of Commercial Steam Pipe Coverings" by L. B. McMillam, M. S. and H. Rekersdres, B. S., '14, will be reviewed in early numbers of *The Wisconsin Engineer.*

REPAIRING BUILDING SUPPORTS AND FOUNDATIONS WITH CONCRETE

A common source of annoyance and expense on the farm is the decay or giving way of building supports and foundations. When this occurs it is considerable trouble to replace these with new timber or ordinary masonry. It frequently happens that a building is in first-class condition while its supports have disintegrated

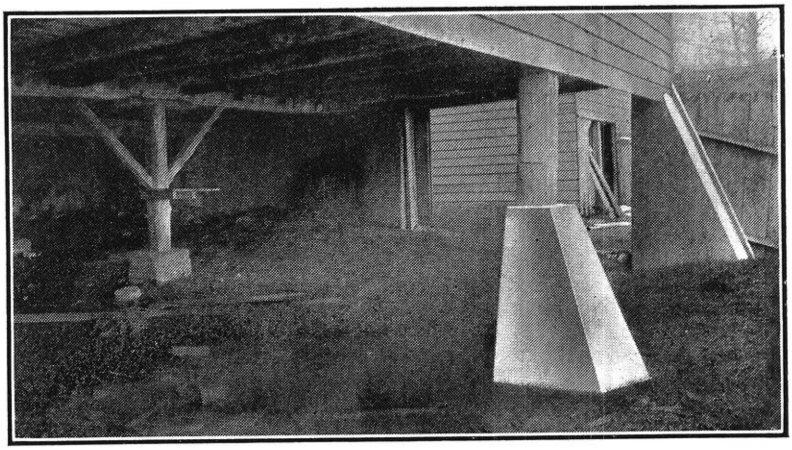

FIG. 1.

or collapsed. For making repairs of this character concrete surpasses any other material. This is due to the fact that it is a plastic substance and may be molded or poured into recesses not readily accessible when another material is used. Timber supports may be renewed without jacking up the building beyond its original elevation.

For example, let it be assumed that a building is resting upon wooden or timber supports which have decayed at the ground level, which always occurs when timber is subjected to alternate wetting and drying. It is an exceedingly simple matter to remedy a situation of this kind with concrete. One has merely to support the building with temporary struts, which should be placed near the post to be removed. The old post should then be sawed off entirely above the rotten part, the suspended part consisting of sound timber. Directly under this suspended post, dig a hole two feet deep and slightly larger than the post itself. Fill the hole with a mixture of concrete consisting of one part Portland cement, two parts sand and four parts stone. On top of this place a box with open ends its inside measurement conforming to the dimensions of the hole. This box should be made and ready to use before any concrete is mixed or placed. Its length should be sufficient to reach from the ground to a few inches above the bottom of the sawed support. When in position, fill it with concrete until the bottom of the sawed-off post is imbedded about a half inch in the concrete. Proceed as above with each support, leaving the boxes or forms in place for one week, and after two weeks the struts used as a temporary support for the building may be removed. The concrete should be mixed thoroughly wet and tamped or puddled with a stick while being placed.

In the case of large buildings elevated quite a distance above the ground, the new support or foundation may be made larger at the bottom than at the top by sloping one side of the box form, as shown in Fig. 1.

TO REPLACE A CONTINUOUS FOUNDATION WITH CONCRETE

This can be done by the farmer with the help of his farm hands even where buildings are quite large and the foundation is of the continuous type, requiring jacking up of the structure. At necessary points remove a few heavy stones or bricks, as the case may be, and insert short pieces of heavy timber to wedge up the building. The building should be carefully raised by this means until entirely free from all foundation. Then remove all of the old foundation and set in place the forms for the concrete. In the case of small buildings it is usually feasible to raise them high enough to allow working room, in which case the form may be filled right up to the top with concrete. The concrete should be a wet mixture consisting of one part Portland cement, two parts sand and four parts stone.

Should the building be too large and heavy to be raised to a height that will give head room, merely make the foundations three inches wider than the sill. Then when the forms are carried to the desired height the concrete may be inserted through this extra space of three inches. To facilitate the placing of the first layers of concrete the top board of the forms may be left off until ready to place the last of the concrete. This last batch should be very wet. The concrete should be tamped until it comes up flush to the bottom of the sill and to the entire width of the wall.

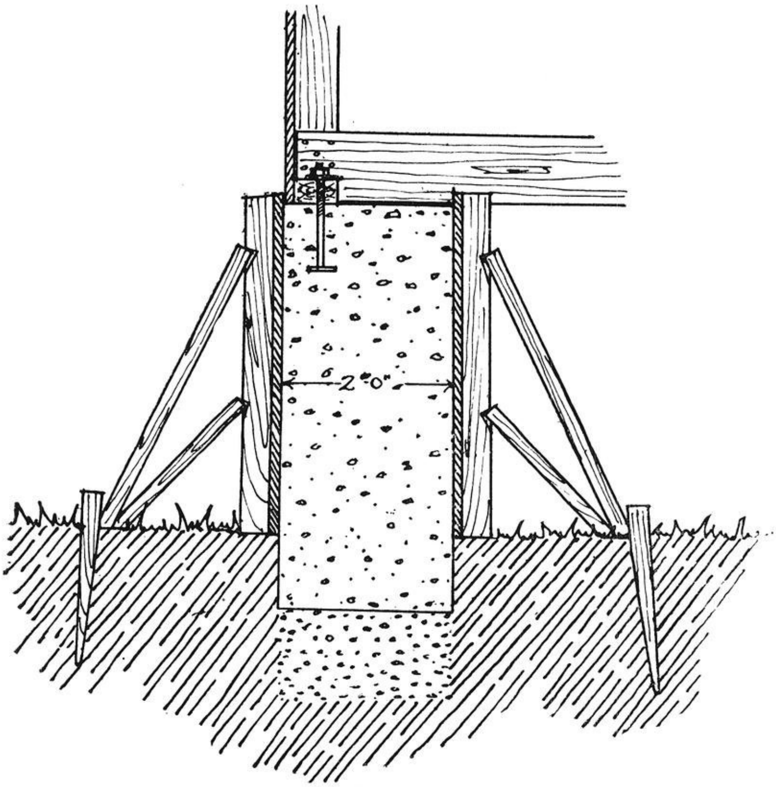

FIG. 2.

Make certain that a space is left in the concrete wall under and on the sides of the underpinning support so that the building may be lowered onto the new foundation and the timber removed. This opening, of course, must be slightly larger than the underpinning support. The building should not be lowered until the foundation has been in place two weeks, and after this is done the openings occupied by the underpinning may be filled with concrete.

Fig. 2 shows how the forms should be constructed.

—Printed by permission of Portland Cement Mfg. Assn.

THE NEW SUMMER COURSE FOR JUNIOR CHEMICAL ENGINEERS

MICHAEL AGAZIM, '15.

During the past summer, for the first time since the course has been established, the junior chemical engineers were required to be in attendance at a summer session. Under the direction of Prof. O. L. Kowalke, they pursued a four weeks' course in chemical manufacture, which was previously offered during the last semester of the senior year. In the future this course will be regularly required during the summer session.

The summer work requirement for chemical engineers was previously satisfied by employment for a summer in industrial work, not necessarily along chemical engineering lines. Owing to the fact that it was impossible for all men to obtain summer employment in chemical work, it was apparent that they were not receiving the desired experience. It was decided that if this experience were gained at the University under the supervision of the faculty, the same requirements could be made of all. This summer course would also give the student the consecutive time he needed for the successful pursuit of work along chemical lines. Furthermore a larger variety of work could be given the student than he could obtain in an industrial establishment.

The aim of the course was to duplicate actual practice as nearly as possible; each assignment was a problem to be solved. The class was divided into groups of two, and each group was given a different problem. No directions were given, hence it was necessary to visit the libraries to obtain the information required.

Most of the subjects assigned were not well covered in textbooks, and a search through the literature had to be made. For instance, in one case the only information available on the purification of French bauxite by means of caustic soda under pressure was found in a German book on aluminum. This search through the technical literature for scientific information was undoubtedly one of the most beneficial features of the course and the experience thus received in learning the various authorities in different fields of knowledge and the different sources of information was very valuable.

The working knowledge thus obtained was incorporated into a preliminary report, which subsequently served as a laboratory guide. It was necessary to have complete chemical control of each process and the first step was an analysis of the raw materials involved, to insure the use of proper quantities. In the case of the experiments on oils, for example, an extraction test was run on the different seeds and the theoretical yield determined for a basis of comparison and cost. The resulting products and residues were analyzed so that the whole process was completely checked and all losses were accounted for. The purity of the final product was determined by making all of the important identification tests. This series of analyses gave a fine practice in analytical chemistry.

Although all the apparatus used in the arts could not be furnished the men, due to the necessarily limited equipment, yet an excellent variety of chemical machinery was available. In some cases the original apparatus served well enough, but sometimes it was necessary to introduce changes before it could be used for the problem in hand. Thus in the expression of oil from the seed, the press cloths were subjected to such great pressure that they broke under the strain. After trying various schemes to prevent this, the use of protecting tin ends finally solved the problem. Similar difficulties arose on other apparatus. Some men had to build their own apparatus, such as furnaces for fusing materials and for testing various substances as powdered fuel.

After the assignment of the problem and the completion of the preliminary report, the men began the work of manufacture. They worked along with an occasional word of advice from the instructor who, however, took the view that they ought to work out their own solution, and gave his tips only when the men were at the end of their resources. Twice a week the whole group met in conference where each man was required to lecture before the class on the work he was doing and to answer any questions which were asked of him by any of the members of the class. In this way all were kept informed about the work which was being done and received the benefit of the experiences in all the problems. The conferences were known as trouble hours, because here all knotty questions were threshed out and settled.

Many interesting problems were tackled. Among them were the expressions of oils from cotton-seed and flax seed, the manufacture of caustic soda, a water softener known as "Permutite," the recovery of potassium chloride and sulphate from kainite, the separation and recovery of the various constituents of old dry batteries, tests on various materials like coal and tan bark as powdered fuels, purification of bauxite, and the manufacture of glass bottles. In some cases the more important experiments were assigned to several groups so that more than one or two would receive the knowledge involved in them. About four of such problems were given to a group in the four weeks' course.

The results of the whole process, including analysis of raw materials and product, chemical control and recovery of by-products, were embodied in a report which gave the complete experience met with in operation. Besides the account of the experiment, the men were asked to figure on a plant for manufacturing the material which they had made. This included a rough estimation of the cost of setting up a plant of a certain capacity, and its cost of operation. In some cases of a rather special nature, the men were asked to suggest improvements on the apparatus which was in use in the laboratory, and to design better apparatus which might be used in the future.

Most of the men plunged into the work with great enthusiasm which was not decreased even when the process did not go as the books and articles on the various subjects stated. There was no shirking of work anywhere, and a great deal of pride and pleasant rivalry was shown by the men in their individual problems. With the knowledge and experience which they gained, both in the technical information and practice in solving a problem, they received a better all around experience in chemical lines than would have been obtained in a factory.

The Wisconsin Engineer.

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The other positions on the staff will be filled after a series of tryouts which are open to ALL engineering students. For further information see the bulletin board.

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EDITORIALS

This is the time of the year when editorial ink flows freely in words of welcome and advice prior to the full assumption of the year's duties. Wherever the "old" student turns, he is confronted with the admonition to profit by previous experience and settle down to serious work at once; and in every publication the "new" man is warned of the efficacy of the present for preventing the unwelcome "con" at mid-semester.

To the engineer there is but one question to be asked. It is the standard by which "new" men are first measured and "old" men continuously classified. It is the spirit which characterizes the engineer in every activity, both in the classroom and out, and which distinguishes him from most other citizens of our hill; a spirit that should be felt by every engineer from the time he enters his first classroom until he receives his sheepskin, and which should guide his every step after he leaves his Alma Mater. The engineer without conscious *seriousness of purpose* is running a race without a goal.

The name engineer is indeed becoming a very popular one. It is the new, the romatic profession. The world stands waiting for the constructive work of the engineer, and so the profession is filling only too rapidly with soldiers of fortune—men attracted by the name rather than the work to be achieved. There are too many listening for the plaudits the profession is earning rather than the call for service.

The appeal then, at the beginning of a new year for some and of the entire course for others, is for *seriousness of purpose*. For which of these reasons are you an engineer? Is it for grandstand play; or for hard, untiring, and unapplauded work?

* * *

Men, like machines, have a rated output. Your generator runs most efficiently on its rated load. If it is below its rating, it is below its maximum efficiency. It will run on a twenty per cent, even a fifty per cent, overload; but not efficiently. Commutator troubles soon develop, the heating becomes excessive, the bearings begin to bind—and eventually the overload must be removed.

It is only too common for a student to work below his rating; and the result is that he carries his load less efficiently. The twenty and fifty per cent overload is also common, and its results just as inevitable. He may be able to carry it for a time; but finally the fuse blows and the whole line is left dead.

The problem is, evidently, to find your own rating. If you are not working at your maximum, find which side of the curve you are on. Dean Turneaure says the same thing in a different way in his *Foreword*. READ IT.

* * *

It will be of interest to readers of the Engineer to know concerning the value placed by commercial technical magazines on the matter that the Engineer is publishing, as evidenced by the number of articles copied verbatim, and printed under our name. Of the articles in the later issues of last year we have had our attention called to the following reprints: "The Effect of Submergence on the Efficiency of a Water Turbine," by E. Dow Gilman, in the March Southern Engineer. "Opening the Line to Chihuahua," by Prof. L. F. VanHagan, in the Railway Review and the Engineering News. "A High Head Hydro-electric Power Development in the Sierra Nevada Mountains," by Walter K. Jessup, in the June Western Engineering.

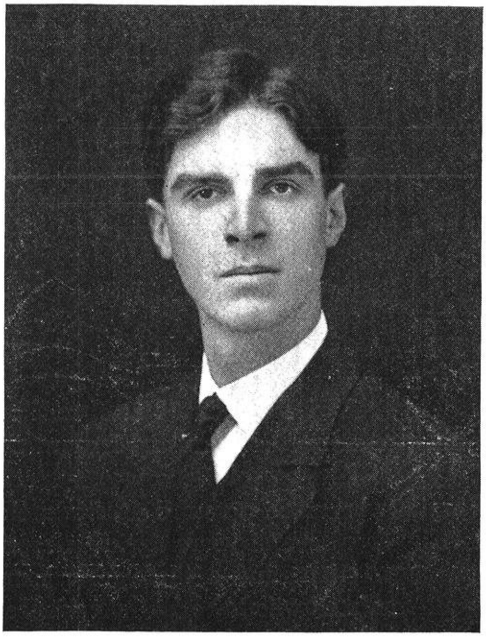
* * *

ALUMNI OF THE COLLEGE OF ENGINEERING:

With this issue of *The Wisconsin Engineer* a new management is in charge of its affairs. For the new management, the retiring members of the staff wish to ask the co-operation of all who are interested in the continued success and larger field of usefulness for the Engineer.

Professor Disque, who made a record as student manager of *The Wisconsin Engineer* several years ago, was recently elected president of the association; and a thoroughly competent staff has been selected from men who have had experience during the past year in the editorial and business departments.

We should like to have every Alumnus of the College of Engineering a subscriber to *The Wisconsin Engineer*, for the journal can then fulfill what we wish to be one of its chief objects, namely: *A frequent and direct means of communication between the College of Engineering and its Alumni.*—J. G. D. MACK, *former president.*



CHARLES MACHEY ROOD.
DIED JUNE 7, 1914.

Charles Machey Rood was born at Reedsburg, Wisconsin, December 23, 1883. His father, Dr. C. A. Rood, is still practicing medicine at Reedsburg. He graduated from the University of Wisconsin, College of Engineering (Mechanical) in 1905; but he never practiced that profession. His calling was with the Y. M. C. A., and immediately after graduation he took the secretaryship of the Y. M. C. A. at the University of Washington, Seattle. He kept this position for four years, then from 1909 to 1910 he was located at the Vancouver Y. M. C. A. Seattle, however, recognized the valuable services of such a man, and therefore gave him the position of secretary of the City Y. M. C. A. He remained at this post until death took him away on June 7, 1914. He was married in 1908 to Alice O. Ekern, and besides the widow he leaves one child, Robert Rood.

ALUMNI

By thorough co-operation with Professor Disque and the Alumni Association, we will endeavor during the year to keep this section absolutely up-to-date, and free from error, and in the nature of a supplement to the Engineers' Alumni Directory issued last May. This can only be realized with the hearty co-operation of the alumni themselves. Every change of position or of address should be noted in these pages and the more readily we are advised of any such changes, the more truly will this section be accurate. Alumni, this is your department.

* * *

The Seniors of last year are now located as follows:

CHEMICALS

Claude N. Hitchcock is with the Bureau of Municipal research, New York City.

Homer A. Piper is Research Chemist with the Eastman Kodak Co., Rochester, N. Y.

Karl W. Klotsch is with the Minneapolis Gas Light Company.

C. A. Fourness is with Vaughn, Meyer and Sweet, Consulting Engineers, Milwaukee.

H. F. Zabel is with the Westinghouse Lamp Works, Bloomfield, N. J.

Harlow Bradley is in the United States Forestry Service Department.

CIVILS

Earl G. L. Swanson is with Robt. W. Hunt, Ins. Exchg. Bldg., Chicago.

E. K. Smith is Asst. City Engineer of Beloit.

Walter P. Bloecher is with the Engineering Dept. of the B. & O. R. R., Baltimore, Md.

George H. Connolly is Asst. City Engineer of Racine.

Frank M. Charlesworth is in engineering work in the Fox River Valley, Wisconsin.

Carroll H. Luckey is with the C. & N. W. Ry.

Chas. W. Ellsworth is with the County Road Comm. of Delta Co., Mich.

John H. Hendricks is rodman, with the New York State Dept. of Highways.

Joseph F. Kunesh is transitman, with the Texas Land & Development Co., Plainview, Texas.

Clarence S. Gruetzmacher is in the office of the City Engineer, Milwaukee.

ELECTRICALS

W. L. Brandel is with the Nat'l Electric Lamp Ass'n, Nela Park, Cleveland.

C. H. Butz is with the Denver Gas and Electric Co.

L. C. Hoffman is with The M. E. R. & L. Co., Milwaukee.

Clark M. Osterheld is Supt. of the Municipal Electric Light System of Stoughton, Wis.

R. L. Replinger is a sales engineer for the National X-Ray Reflector Co., Chicago.

Albert C. Jones is with the Western Electric Co., Chicago.

John W. Millspaugh is a salesman for the Chain Belt Co., Milwaukee.

H. E. Kranz is Instructor in Electrical Engineering in the U. W. Extension Division, Room 310 Ext. Div. Bldg.

Melbourne O. Reed is in the Educational Course of the Western Electric Co., Chicago.

William H. Tolhurst is with the Wyoming Electric Co., Casper, Wyoming.

A. R. Taylor is Cadet Engineer with the Denver Gas and Electric Co.

M. W. DeMerit is Student Engineer with the G. E. Co.

Gilbert E. Laue is with the Cutler-Hammer Co.

F. J. Schmidt is with the Westinghouse Elec. and Manfg. Co., 39 So. La Salle St., Chicago.

G. M. Chritzman is with the Commonwealth Edison Co., Chicago.

Godfrey Johnson is in the Test Course of the General Electric Co., at Schenectady.

Mac Lean Houston is Cadet Engineer with the Denver Gas and Electric Co.

John W. Young is with the Potlach Lumber Co., Elk River, Idaho.

A. J. O'Connor is with the Milwaukee R. & L. Co.

MECHANICALS

E. R. Sagen is taking the apprentice course at Allis-Chalmers Company, Milwaukee.

Ivan A. Bickelhaupt is with the Des Moines Bridge and Iron Works, Des Moines, Iowa.

Leo Cowin is an apprentice at the Westinghouse Plant at East Pittsburg.

R. S. Dewey is in a seed house at Caldwell, Idaho.

A. G. Elsby is in the Student Course of the Chain Belt Co., Milwaukee.

L. B. McMillan is an Instructor in Steam and Gas Engineering at the University.

W. F. Miller is with the Chain Belt Co., Milwaukee.

Henry Rekersdres, m '14, is working for the American Blower Company at Detroit, Michigan, where he is taking a special course in Sales Engineering.

MINING

Waldemar A. Knoll is with the Newport Mining Co., Ironwood, Mich.

S. L. Houghton is with the Fortuna Consolidated Mining and Milling Co., operating in New Mexico.

J. C. Scoles is with the Newport Mining Co., Ironwood, Mich.

Wm. S. Carpenter is with the Menominee Land and Iron Co., as their mine representative.

Mack C. Lake is Asst. Geologist to C. K. Leith, Madison.

* * *

W. H. Hauser, m '04, has been appointed Mechanical Engineer of the Chicago and Eastern Illinois Railroad under date of August 1, 1914. His headquarters will be at Danville, Illinois.

In a photograph which appeared in the Rocky Mountain News & Times of the new class of cadet engineers at The Denver Gas

& Electric Light Company, six out of the thirty-nine men were from Wisconsin University. This is the largest representation that any school has got in that number. The Wisconsin men are: J. W. Griswold, '13; A. R. Taylor, '14; McLean Houston, '14; R. C. Newbury, '12; F. M. Rosenkrans, '13; and C. H. Butz, '14. The paper concludes a rather lengthy article about the course given to the young student engineers with the following:

"One of the students of the School of Practice, H. H. Scott, for several years manager of all the Doherty properties, was recently elected president of the National Electric Light Association, which is composed of all the electric light companies in the country. Scott is a graduate of the University of Wisconsin, which has supplied the Doherty organization with a large number of its brilliant engineers."

Arch Taylor, e '14, writes us that J. W. Griswold, m '13, is assistant to the special industrial fuel man and is no longer ranked as a cadet. Congratulations Griswold!

The Denver Colony were visited early in July by V. H. Volquarts, m '13, who is the superintendent of the American Zinc Company, Kansas City, Kansas.

J. C. Taylor, e '01, who is the district manager of the Denver Rock Drill & Manufacturing Company, is establishing an eastern office at Houghton, Michigan, for the company.

R. C. Newbury, e '12, who was formerly at Toledo is now at Denver and has charge of the design of the switch board for the Tacombe Station and for the substations.

The Wisconsin Colony at Denver has been depleted by the transference of W. D. Moyer, m '12, M. E. '13, and F. M. Rosenkrans, e '13, to the statistical department at New York by the Doherty Operating Co., with whom they are connected.

E. J. Arps, '13, is in the operating department of the Commonwealth Edison Co., Chicago.

Abner Hendee, '13, is in charge of the engineering department of the Herman Andrae Electrical Co., Milwaukee.

R. T. Herdegen, e '06, who was with the A. O. Smith Co. at Milwaukee, is now connected with the Dominion Stamping Co., Ltd. of Walkerville, Ontario, as vice president and factory manager.

J. K. Cook, m '09, has left the C. M. & St. P. R. R. and is now at Shawnee, Okla. with the C. R. I. & P. R. R. His address is 208 N. Beard St.

The firm of Parmley & Nethercut, Consulting Engineers, has dissolved. Mr. Parmley, m '87, is now a Sewerage and Reinforced Concrete Engineer, 45 E. 17th, N. Y. City. Mr. Nethercut is at 705 Michigan Ave., Evanston, Ill.

A. F. Gilman, c '10, formerly rodman with the C. & N. W. R. R. at Boone, Ia., is now drafting in the office of the Chief Engineer of the C. St. P. M. & O. R. R. at St. Paul.

O. W. Melin, c '10, is now at 1014—16th Ave., Moline, Ill.

M. N. Murphy, e '01, formerly at Omaha has taken a position with the Gray Bros. Electric Co., 160 Cass Ave., Detroit.

W. C. Epstein, m '13, is located in the shops of the Rock Island Railroad at Moline, Illinois.

Edward F. Wilson, m '84, has drifted into patent law work of late years, and is now admitted to practice law in the courts of Illinois. Mr. Wilson was formerly engaged in the designing of special machines and tools.

J. F. Alexander, e '11, thinks that we are right in stating that a great many of the Wisconsin Graduates seem to become estranged from the University soon after graduation. We hope that the alumni will continue to write us as much as they have been doing the past month and then there will be no opportunity for estrangement.

J. G. Bock, c '07, who has been Assistant Engineer of the C. St. P. M. & O. Ry., at St. Paul, Minn., has been appointed General Bridge Inspector of the same corporation.

P. J. Carter, c '04, who was Office Engr. of the Santa Fe Road at Amarillo, Tex., is now Asst. Engineer stationed at Albuquerque, N. M., 630 N. 5th St.

W. W. Kuestermann, e '09, has recently accepted an instructorship in Mathematics at the University of Michigan. He had a similar position at the State College of Pennsylvania.

F. E. Kruesi, e '08, is now Superintendent of the Freeport Ry. and Light Co.

Edgar Kearney, m '06, is now Junior Fuel Engineer at the Bureau of Mines, Washington, D. C. His address is The Dresdan Apt. No. 75.

G. McNaughton, c '09, has been transferred by the Forest Service Department from Wausau to the Forest Products Laboratory at Madison.

E. D. Gilman, who has been taking graduate work at the University has taken the position of Office Engineer in the City Engr.'s Office of Duluth.

E. A. Jacob, c '13, is now the Resident Engineer of the Sevier River Land and Water Co. at Lynndyl, Utah.

W. E. Jessup, C. E. '12, has left the Stone, Webster employ and is now with the U. S. Reclamation Service at Phoenix, Ariz.

R. H. Ford, e '09, has been transferred by the General Electric Co. from Lynn, Mass., to their plant at Fort Wayne, Ind.

H. L. Algeo, c '13, is now Asst. Engr. of the Rivers and Lakes Comm. of Ill., with headquarters at 1534 Transportation Bldg., Chicago.

H. M. Beebe, c '11, formerly Draftsman, is now Estimator for the Link Belt Co., Milwaukee.

E. P. Abott, c '08, has been transferred by the Guthrie-MacDougall Co. from Spokane to Portland, Ore.

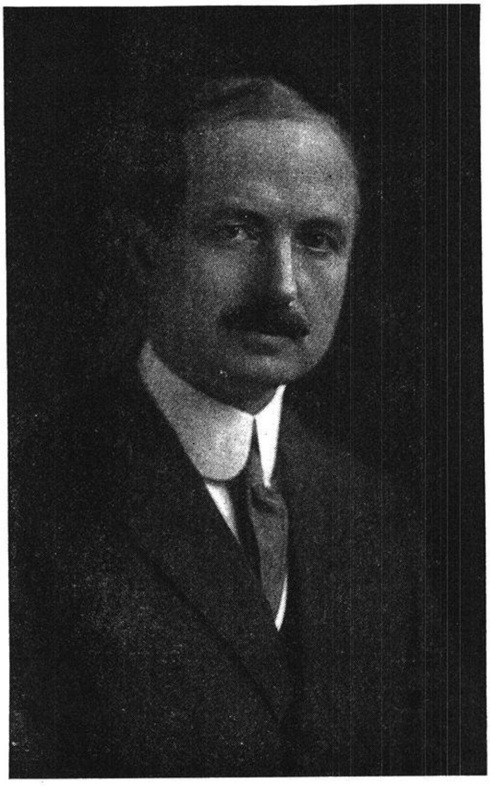
Mr. J. H. Griffith, '93, writes us that he spent a very pleasant afternoon at the A. S. C. E. Convention at Baltimore with Mr. Henry Fox of the class of '92, who is now Chief Engineer of the Baltimore Dredging Company, Baltimore. Mr. Fox has large interests in river and harbor work, his first engineering work being with the C. & N. W. Ry.

Mr. Griffith is president of the Pittsburgh Alumni Association and reports a very "live" organization there. They meet several times a year for smokers and have a yearly banquet about June. They were the initiators of the "Big Meet" recently held by ten universities in the east.

WISCONSIN ENGINEERS—AND HOW THEY DID IT

Editor's Note:

We are all interested in the men who have brought the Engineering College honor and prestige by the great success they have made in their profession. The careers of these men are



G. G. Thorp, '91.
Vice President Illinois Steel Co.

worth studying and following; and it is with this purpose in view that sketches of some of our successful engineers will be printed in every issue. It is our greatest regret that lack of space prevents us from publishing as many sketches as we would like to.

During the year following his graduation from the mechanical engineering department, Mr. G. G. Thorp held a fellowship at the university, dividing his time between instruction and research work.

Since he left the university in 1892, he has been continuously engaged in the iron and steel business. In 1892 he entered the service of the Illinois Steel Company as superintendent of the testing department at the North Works. Shortly after this he was transferred to the Joliet Works of the same company with the title of Assistant Master Mechanic, and was given charge of the maintenance of the mechanical equipment.

In 1895 Mr. Thorp severed his connection with the Illinois Steel Company and became master mechanic and chief engineer of the Colorado Fuel & Iron Company at Pueblo. In this position he had charge of the design, construction and operation of the mechanical equipment. When he returned to the Illinois Steel Company in 1898 he became assistant general superintendent of the Joliet Works and was soon afterward made general superintendent of those works.

The most important work done by Mr. Thorp during the next four years was the design and construction in 1901 of the Clairton Steel Works located near Pittsburgh. Shortly after the completion of these works they were absorbed by the United States Steel Corporation. At this time Mr. Thorp was made vice-president of the subsidiary Illinois and Indiana Steel Companies, in charge of the design and construction of the plants in the Chicago district, including the Gary plant.

In addition to his connection with the steel companies, Mr. Thorp is vice-president of the Gary Land Company and Director of the Gary State Bank, also member of various clubs and technical associations, among them being the University Club of Chicago, The Chicago Club, the American Society of Mechanical Engineers and the American Iron & Steel Institution.

CAMPUS NOTES

THE ENGINEERING CORPS, FIRST REGIMENT, U. W.

P. G. Wrightson.

1st Lieut. U. S. Infantry, Commandant.

The corps, or rather more strictly speaking, the detachment, was organized under Captain Ball three years ago. The membership was limited to sophomores in the Engineering College. It was officered by a captain and three lieutenants, and its enlisted strength was about fifty men. Although designed primarily as a technical company, much of its time was spent in close order drill and only a small proportion of the time devoted to the engineering side of the work. Nevertheless, with enthusiastic efforts on the part of officers and men, some very creditable work was turned out by the company each year.

At the first annual inspection, in 1912, the company constructed on the campus a military bridge, imagining certain widths and depths of water. The next year, 1913, at the request of President Van Hise, the company constructed two bridges of a permanent character back of the hydraulic laboratories on the University Drive. The spaces spanned were rather narrow to show the full possibilities of the bridge types selected, or to call forth the full powers of the men in the company. Both the lock and sling bridge are shown and their permanency insured by the use of iron bolts and wire cables instead of wooden pins and ropes. Not only do they illustrate military types of crossing streams but they are an object lesson which may be of value to the farmer or small village as an inexpensive, simple bridge for country use. This year, 1914, the company surveyed, laid out, and constructed the target range. This is a four target affair; a pit about sixty feet long, eight feet deep and six wide. The forward face of the pit is revetted with two by twelve planks. The rear face is cut to a normal slope. Excavated earth was thrown to the rear to aid as a bullet stop.

Although the company has shown itself capable of doing the manual labor involved in constructive works of the kind mentioned above, the department must bear in mind that the function of the engineers in the regiment is not primarily muscular. If brains are worth anything, if ability to plan and direct are of more value than wielding pick and shovel, the military department must find a way of teaching rather than drilling the engineer company. In real service, the engineers are highly trained and it is expected that in time of war there will be details from the line companies to do the actual labor under supervision of the engineers. Accordingly next year the company will be reduced to a detachment of twenty-one picked men; a captain, a lieutenant, three sergeants, two corporals and fourteen privates. They will make a careful study of the army text on field engineering, meeting once a week in class room, where they will work out with model materials the problems involved. They will attend the sophomore Friday afternoon lectures given by the commandant. They will do no drill until April and then only enough to show creditably in the four general formations of the entire corps. The practical nature of the final problem has not yet been determined but it will be as nearly as possible similar to one which might easily occur in actual campaign.

THE ENGINEERING SOCIETIES OF THE UNIVERSITY

At the beginning of the year the engineer is confronted with the question of the advisibility of affiliating himself with one of the technical clubs of the college. To the new men the objects and methods of the various clubs are hazy indeed, and as a result there is undue hesitancy in showing any interest in this direction. With these questions in mind, the secretaries of the various organizations have prepared brief statements setting forth the formal facts concerning their societies, and these we publish herewith.

* * *

This year will bring the twentieth anniversary of the University of Wisconsin Engineers' Club, which is the oldest organization in the Engineering College. Membership is open to any engineer regardless of the course he is taking, and although the number is limited, the graduation of members last spring has left plenty of room for new ones.

The society meets every Friday evening for the discussion of papers given by the student members or visitors. The manner of delivery is closely observed, for it is the purpose of the society to develop a man's ability to deliver a paper or discuss a proposition, as well as to train him to be good mixer among the men of his profession.

There are many plans on foot for social affairs, and the old members hope that the new ones will hurry in to help them celebrate their twenty-year birthday party. Visitors are always welcome to any programs given by the society, a notice of which is always posted on the bulletin board a week beforehand.

* * *

To the "mechanicals," the A. S. M. E. appeals first, and this technical-social organization is making a strong bid for the support of every eligible mechanical. The programs of the regular monthly meetings call for speakers not only from the students and our own faculty, but from prominent faculty members from other colleges, and also from engineers prominent in the professional world. The social phase of the society's activities will come in one or two mixers during the year, where the members may become really acquainted.

* * *

The Civil Engineering Society in their regular meetings will follow the talks by the members by general discussions. Music will be made a part of some of the programs. Prominent engineers and men in other professions will address the society on topics of general interest. All engineering students are invited to attend. A get-together smoker will be held soon after registration, and the annual dance is scheduled for the first semester.

* * *

The Mining Club is primarily for instructors and students of Mining and Metallurgy, but is also open to those interested in Geology and General Mining. Bi-monthly meetings are held and every member is given a chance during the year to accustom himself to speaking in public. Those phases of mining, metallurgy, and geology which are interesting and instructive, and those bits of experience and practice picked up by the individual members at various mines will be attractively presented.

DEPARTMENTAL NOTES

HYDRAULIC ENGINEERING

The American Red Cross, acting with the cabinet ministers of the Republic of China, has selected a board of eminent engineers for the purpose of reporting on the practicability of the prevention of floods and the resultant famines in the Huai River section. The board consists of Col. William L. Sibert of the corps of engineers, U. S. A., builder of the Gatun locks and dam at Panama, chairman; Arthur Powell Davis, chief engineer of the United States reclamation service, and Daniel Webster Mead, professor of hydraulic and sanitary engineering, at The University of Wisconsin.

The commission sailed with a corps of assistants, from Vancouver for China on June 11, and will spend four months in laying plans to prosecute one of the greatest engineering works.

The work will be conducted under great difficulties, owing to climatic conditions, swampy lands, etc.

Professor Mead is planning to visit some of the large irrigation systems and other engineering work of interest in India and Egypt before returning to this country and expects to return some time in October.

* * *

Dean George Jacob Davis, Jr., of the college of engineering, University of Alabama, formerly in charge of the Wisconsin hydraulic laboratory, was engaged as research assistant for the summer and has prepared a University bulletin on *The Hydraulic Ram.*

* * *

Professor Harry N. Lendall, in charge of the engineering school of Rutgers College, New Jersey, was engaged in advanced experimental research work at the hydraulic laboratory during the summer session.

* * *

Mr. Byron Bird, B. S., Iowa State College, has been appointed research assistant in hydraulic engineering for the year 1914–15.

* * *

Mr. R. B. Clement, B. S., Dartmouth College, and Mr. Guy E. Whitman, B. S., University of Alabama, have been awarded scholarships in hydraulic engineering.

* * *

The first University bulletin of the newly created Engineering Experiment Station has been published recently. The subject is *The Diaphragm Method for the Measurement of Water in Open Channels of Uniform Cross-Section,* by Carl Robert Weidner, C. E., instructor in hydraulic engineering.

STEAM AND GAS ENGINEERING

The loss of the very efficient services of Prof. A. G. Christie, due to his removal to the Engineering Department of Johns Hopkins University, has necessitated some changes in the Steam and Gas Engineering Department.

* * *

Mr. W. Black, who has been at Wisconsin for five years, has been promoted to the position of assistant professor with direct charge of the laboratory work.

Prof. E. G. Hoefer, '05, Professor of Mechanical Engineering at the University of Wyoming, has accepted a position with the department for the year 1914–1915, and will give work both in the class room and in the laboratory.

* * *

Mr. L. B. McMillan, who has held a scholarship last year and received his Master's degree last June, has been appointed instructor in the department.

* * *

Prof. G. L. Larson, of the University of Idaho, has been appointed fellow in the department and will devote practically his entire time to research in heating and ventilating problems.

ELECTRICAL ENGINEERING

The photometric equipment of the standards laboratory is being rebuilt and remodeled. The new apparatus consists of lamp rotators, sight boxes, a transformer, and a special sector disc. The latter is used for cutting down the amount of light. It will be motor driven and very similar to the one used in the Bureau of Standards. Coils which have just been wound for the new transformer will extend the range of the standards laboratory to one thousand amperes A. C. Many new instruments have also been purchased for the laboratory and field work.

ESTIMATED COST OF METER TESTING WORK IN THE FIELD

Mr. F. A. Kartak, director of the Standards Laboratory, has sent out circular letters to those public utility corporations which have not complied with the law in regard to having meters tested once every year. The tests are made either in the laboratory at the university or in the field by experienced meter testers. The university rents standard instruments and equipment for the field tests at a rate of from one to three dollars for the first week or fraction, depending upon the initial cost of the instrument, with a charge of twenty per cent of this base fee for each additional week or fraction.

All test instruments are calibrated before being sent out of the laboratory. A calibration fee is charged for this work according to the adopted schedule of fees; the amount being $1.50 or more.

The laboratory will recommend, if so requested, reliable and experienced meter testers, who receive from $3.50 to $4.00 per day (of eight hours), together with transportation and living expenses. When such recommendations are made, all subsequent transactions relating to such services are between the man recommended and the public utility.

As a result of field testing work which has been done by men recommended by the Laboratory in the past, it has been possible to form an approximate estimate of the cost of performing the routine meter testing work. The ccst per meter of inspecting, cleaning and readjusting depends upon the size, type and age of the meter, as well as its condition and accessibility for testing purposes. The unit costs given below are for two wire meters only of five and ten amperes size for 110 or 220 volt operation, and, while conservative, may be subject to 20 or 30 per cent variation (in some cases even more), depending upon the factors cited above.

COST OF TESTING PER METER

Commutator Type	$0.75
Induction Type	0.65

PROFESSIONAL AND BUSINESS CARDS

EDWARD F. WILSON
U. W. '84
Patent Lawyer
630 Marquette Building
Chicago, Illinois

ALLAN D. CONOVER
Architect
36 Tenney Block Madison, Wis.
Specializes in Institution Work

CLINTON B. STEWART
Assoc. M. Am. Soc. C. E.
Mem. West. Soc. Engrs.
Consulting Hydraulic Engineer
Water Power Water Supply Drainage
206 Wisconsin Bldg. Madison, Wis.

Francis A. Vaughn, U. W. '95, Arthur J. Sweet, Hans J. Meyer
VAUGHN, MEYER & SWEET
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Illuminating Engineering
Appraisals
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CHARLES V. SEASTONE
Consulting Engineers
Madison, Wisconsin

ARCHIBALD O. POWELL
Member American Society of Civil Engineers; Member Canadian Society of Civil Engineers
Consulting Civil Engineer
404 Central Bldg. Seattle, Wash.

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