The Wisconsin engineer. Vol. 21, No. 6 March 1917

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

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The Wisconsin Engineer

VOL. XXI MARCH, 1917 NO. 6

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A TEST OF THE MAGNETON THEORY

EARLE M. TERRY, Ph. D.
Assistant Professor of Physics, University of Wisconsin

One discovery after another during the past fifteen years has established beyond a doubt, that electricity consists of indivisible units, the negative electrons, whose properties are independent of the matter from which they originate. Investigations in such widely separated fields as radiation, discharge through gases, and radio-activity have shown that the electronic mass, which is electromagnetic in character, is about one eighteen hundredth as heavy as the lightest known chemical element, hydrogen, and that its charge is 4.81 x 10.10 electrostatic units. By starting with a nucleus of positive electricity, concerning whose nature relatively little is known, and by supposing the negative electrons to revolve about it in orbital motion, a theory of the constitution of the atom and of the structure of matter has been built up which has met with marked success.*

An attempt has been made by Weiss to explain magnetic phenomena in a similar manner by assuming the existence of indivisible magnetic particles called the "magnetons," a definite number of which is supposed to occur in each atom of paramagnetic substance. This theory, which is in reality a modification of the old Weber theory, assumes that the molecules of a paramagnetic substance, are, as in a gas, free to orient themselves in all directions; and that under the influence of an external field, which tends to line them up, and the thermal agitation, which tends to disorganize them, the distribution of the directions of the magnetic axes is given by the Maxwell-Boltzmann law, which is of fundamental importance in the kinetic theory of gases. The intensity of magnetization depends then only upon the temperature and the external field. These con-

* Thompson's electronic hypothesis of matter.

siderations lead, without difficulty, to the law, discovered experimentally by Curie, that the susceptibility* of a paramagnetic substance is inversely proportional to the absolute temperature.

Ferro-magnetism, according to this theory, is accounted for by assuming that the internal alignment, started by an external intensity of magnetization, which, in some cases, amounts to several million gausses. In applying the Maxwell-Boltzmann law to ferro-magnetic substances, this is the field which must be considered. Using these ideas, Weiss obtained a general relation between intensity and temperature, which, when put in the *form of corresponding states,* represents the experimental facts with a fair degree of accuracy. He showed that in the *region* of "induced ferro-magnetism," that is in the temperature interval immediately above the point at which ferro-magnetism disappears (785 degrees C. for iron) the susceptibility should follow a modified form of Curie's law. It should be, in other words, inversely proportional to the excess of the temperature above the transformation point, where the constant of proportionality is the same as would have held for the substance, if, by the suppression of the mutual actions between molecules, it had remained para-magnetic.

As a result of their study of magnetic properties at very low temperatures, Weiss and Kammerlingh Onnes, working in the Cryogenic Laboratory at Leyden, found that at temperatures only a few degrees above absolute zero the saturation values of the magnetic moments per gram atom for iron, nickel, and cobalt are to one another in simple ratios, namely, 11:3:9. To the aliquot part common to the magnetic moment of the gram atom, Weiss has given the name of gram magneton, and this quantity divided by the Avogadro number (number of atoms per gram

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* It is convenient in this work to define the magnetic state of a substance in terms of its susceptibility $k=\frac{I}{H}$ rather than its permeability $\mu=\frac{B}{H}$ as is customary in engineering practice. These quantities are connected by the relation $K=\frac{4\pi}{\mu-1}$. Further, it is the mass susceptibility rather than the volume susceptibility which is used and will be designated throughout by the letter x, which is volume susceptibility divided by the density.

molecule) gives the moment of the ultimate magnetic corpuscle, which he has called the "magneton". His theory further shows that the number of magnetons per atom is related to the Curie constant in a simple manner, so that it is easy to put the theory to test by determining first, whether all substances obey Curie's law and second, whether an integral number of magnetons per atom may be deduced from their Curie constants. The temperature variation of magnetic properties thus becomes a matter of prime importance from the viewpoint of this theory.

Using the results of Curie, Pascal, Weiss and Foëx, Leibknecht and Wills, and Miss E. Feytis, which constituted the best data available at the time the theory was proposed (1908). Weiss found that ferro-magnetic substances at high temperatures and their salts at ordinary temperatures, give, for the number of magnetons per atom, values which rarely differ from integers by more than one or two per cent. Similar results were obtained for a large number of alloys of iron, nickel and cobalt.

On the other hand, Honda and his students, after examing a large number of substances, both elements and compounds, have obtained considerable evidence that Curie's Law is not a general law of nature, and that the existence of their magneton, at least as based on the simple theory of Weiss, is open to serious question. Moreover, Kammerlingh Onnes and his co-workers have extended their thermo-magnetic studies to very low temperatures with a view to testing the validity of Curie's law in this region, and have found that, while it holds for many substances, it shows marked departures for others.

Curie's classical work was carried out at a time when the subject of pyrometry was in its infancy, and his temperature scale is in error by at least twenty degrees. Weiss and Foëx could not extend their work to the melting point temperatures of the ferro-magnetic substances because of oxidation, and the effects of the hydrogen atmosphere, which inevitably filled their furnace chamber and made their results doubtful. The same criticisms may be made of the work of Honda, whose experimental equipment was quite similar except that an atmosphere of nitrogen was used. Moreover, in the work of Weiss and Foëx, certain deviations from Curie's law are apparent in the case of iron, nickel and cobalt. Since it is of extreme importance from the viewpoint of the magneton theory to have accurate information regarding the thermo-magnetic behavior of these cardinal magnetic substances, the present investigation was undertaken with these objects in view: (1) to extend the work to the melting point, (2) to eliminate errors due to effects of oxidation by working in a good vacuum, (3) to eliminate the effects of occluded gases by melting the specimens in a vacuum before testing, (4) to improve previous temperature measurements.

The method of measurement employed was that of Faraday, in which the susceptibility is deduced from the mechanical forces exerted upon a specimen in a non-uniform field. For an object of small dimensions, placed in the plane of symmetry between the poles of a magnet, the force F in a direction X at right angles to the field H is given by the expression

$$F = mXH \frac{dH}{dX}$$

where m is the mass of the specimen and X its susceptibility. The product $H \frac{dH}{dX}$ may be determined for a particular place in the field by substituting for the test specimen one of known susceptibility and measuring the force upon it. This force F was measured by means of a modified form of the Curie balance as shown in figure 1. The specimen was supported by means of a slender porcelain tube carried by an aluminum arm and counterpoised by an adjustable threaded lead nut W. When the magnet NS is energized, the specimen is attracted toward the stronger part of the field and the couple due to this attraction is counterbalanced by the electrodynamic action between the currents supplied by the coils a and b, the former of which is fixed while the latter is mounted on the moving system. A spot of light focused by the concave mirror M on a distant scale indicates when a balance has been obtained. Since the torque is proportional to the current in each coil, this form of instrument may be used for large ranges of forces and has the advantages of high sensitivity and easy control when mounted within a vacuum chamber.

The furnace consisted of a tube of Berlin porcelain closely wound with a 0.5 mm tungsten wire. Outside of this was placed

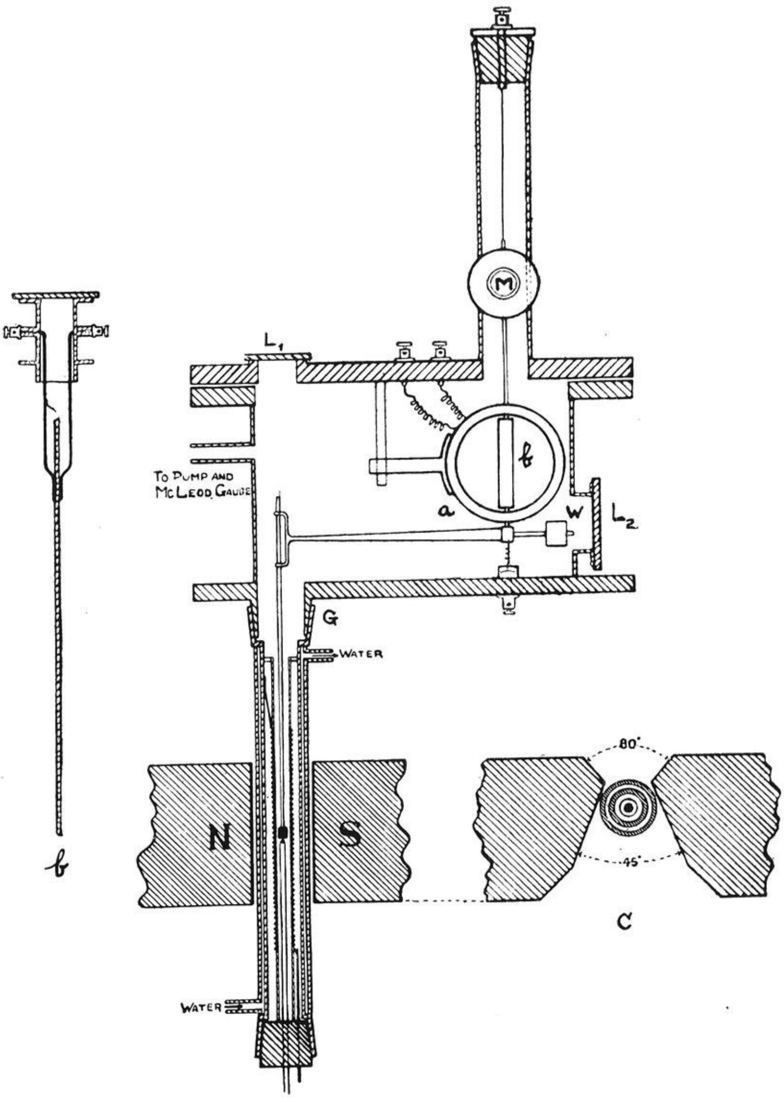


FIG. 1

another porcelain tube (not shown in the figure) and the whole mounted inside a water-cooled jacket, which was supported from the bottom of the vacuum chamber by means of the ground joint G. An input of 750 watts sufficed to produce a temperature of 1500 degrees C.

Temperature was measured by means of an Heraeus platinum, platinum-rhodium thermo couple mounted immediately below the specimen. In its calibration the following melting points were used: cadmium, 320.9 degrees C.; antimony, 630 degrees C., gold, 1062 degrees C.; and nickel, 1452 degrees C. In using the first two of these, the test specimen was swung to one side of the furnace and a tiny crucible of pure magnesia containing a particle of the melt specimen was lowered through the window L1 till it hung beside the test specimen. A vacuum was then obtained and the temperature gradually raised. The specimen was illuminated by light from a nearby arc reflected into the furnace by a prism placed upon L2 and observed by a telemicroscope. The gold and nickel melting points were obtained by means of the apparatus shown in b, figure 1. The melt specimen, in the form of a narrow strip of foil, was supported by platinum wires at the end of a slender porcelain tube inserted through L1 and made tight by a ground joint. The foil was used as a fuse in an electric circuit containing a relay which actuated a buzzer when the melt occurred. It is to be observed that the thermo couple was thus calibrated in the same furnace and under exactly the same conditions as when used for the measurement of temperature.

The magnet employed was a powerful one, weighing 800 pounds and requiring 4 kilowatts for full excitation. It had pole pieces 10 centimeters in diameter and was mounted upon a carriage which rested upon two rows of steel balls running in grooves. It could thus be easily moved to and from the test specimen by means of a slow motion screw operated from the observation table two meters distant. Since the pull upon the specimen depends upon its location in the field, it must always be kept in the same position. The point selected for this purpose was that at which the pull is greatest. This point is easy to find and gives maximum sensitivity.

The vacuum was obtained by a molecular pump and read on a McLeod gauge. Since porcelain occludes large quantities of air and water vapor it must be baked out at low temperatures for several days. By taking proper precautions in this respect, it was possible to operate at the melting point of iron with a pressure which seldom exceeded .0005 mm. of mercury. The pump was run continuously during all measurements. Two dishes containing P_2O_5 were placed within the vacuum chamber near the opening to the furnace—a precaution absolutely essential to the life of a tungsten furnace and a platinum thermo-couple used within it. The assembled apparatus is shown in figure 2.

The iron used in this investigation was Burgess electrolytic, which is known to contain no more than .02 per cent of foreign metal. The nickel and cobalt were obtained from Kahlbaum in the form of powders guaranteed to be free from cobalt and nickel. All specimens were freed from occluded gases by being melted in vacuo in crucibles cut from plates of pure magnesia from the Berlin Porcelain Factory. This is believed to be a very important precaution as a large evolution of gas, at the melting point, is evidenced by a vigorous boiling which lasts for several seconds and then subsides. In fact, experience has shown that it is quite impossible to obtain consistent results at high temperatures unless gases are thus eliminated.

The results are shown by the curves of figure 3, in which susceptibility is plotted as a function of temperature. To assist in comparing with the theoretical results, reciprocal of susceptibility is also plotted against temperature, which, if Curie's law is obeyed, should give a straight line. It is to be observed that only in the case of Beta nickel is any tendency toward a straight line apparent, and even here the law holds for but limited regions. For Beta iron and cobalt the curve shows a distinct upward concavity. Gamma iron is particularly interesting, for it shows an interval of nearly 500 degrees in which the susceptibility is nearly constant, varying by less than ten per cent. At 1400 degrees C. there is an abrupt increase in susceptibility when the transformation to the Delta state occurs, throughout which there is an approximately linear decrease until the melting point (1532 degrees C.) is approached. Molten iron has a susceptibility approximately given by the extrapolation of the curve for the Gamma region. The susceptibility curve for cobalt shows a distinct knick on passing through the melting point

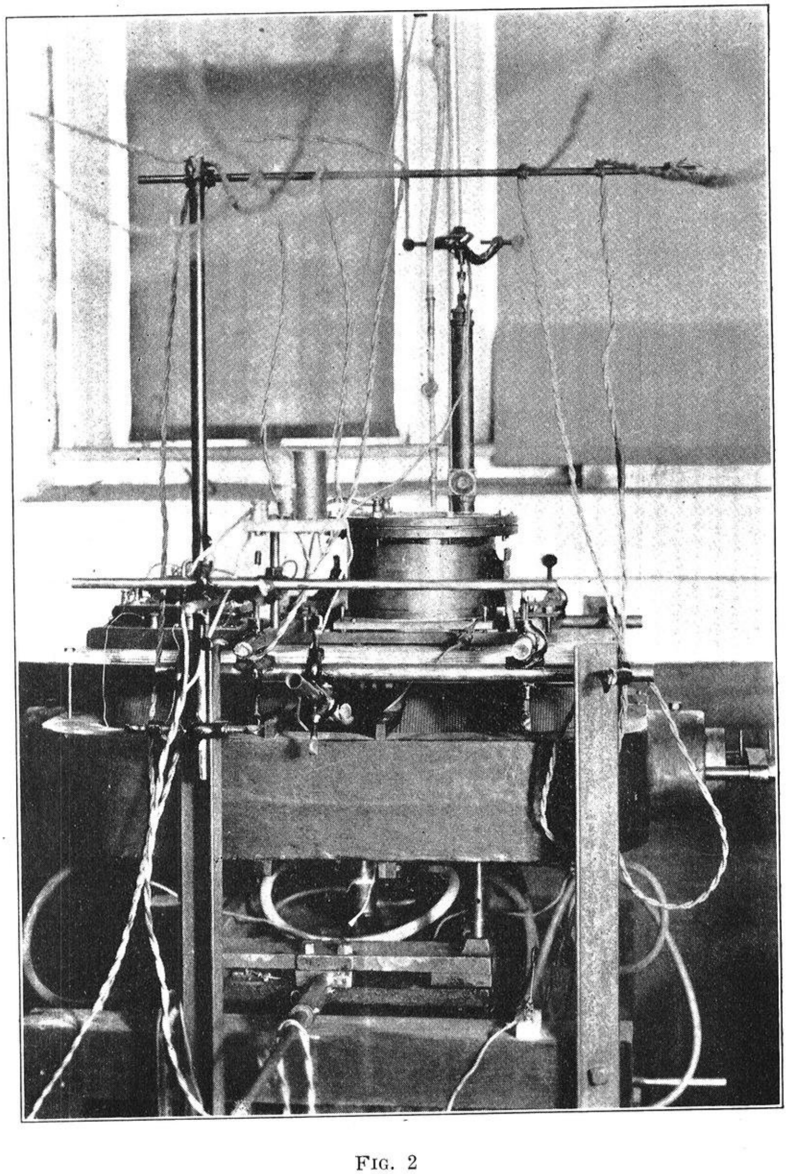
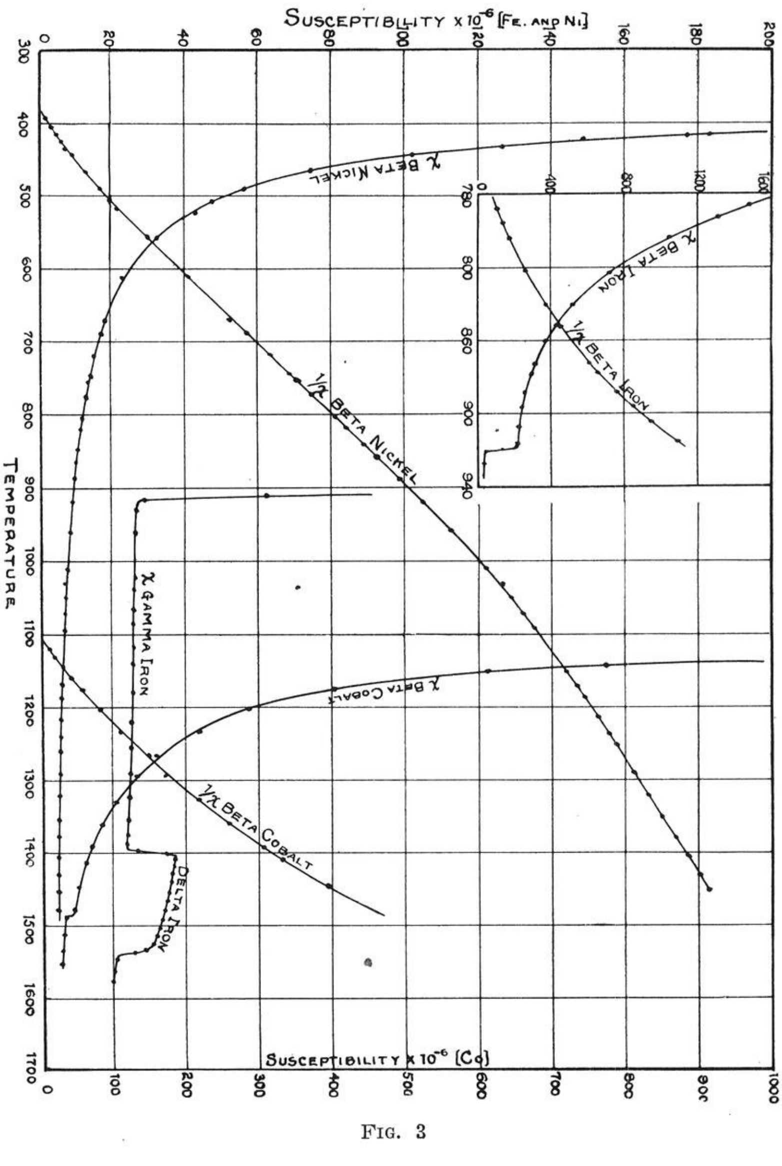


FIG. 2



SUSCEPTIBILITY x 10^-6 [FE. AND NI]
TEMPERATURE
SUSCEPTIBILITY x 10^-6 [Co]
χ BETA NICKEL
1/χ BETA NICKEL
χ GAMMA IRON
DELTA IRON
χ BETA COBALT
1/χ BETA COBALT
χ BETA IRON
1/χ BETA IRON

FIG. 3

(1490 degrees C.) whereas in the case of nickel, (1452 degrees C.) it is continuous.

These results are in marked disagreement with those of Weiss and Foëx, who found Curie's law to hold in all cases. For Beta iron, cobalt and nickel at low temperatures they found, however, that their points for the reciprocal of susceptibility against temperature did not lie on a single straight line but on two straight lines with well defined points of intersection, and they accordingly speak of $Beta_1$ and $Beta_2$ regions. My experiments have been repeated a great many times, and in no case have I ever found evidence of two straight lines, but always a smooth curve. For Gamma iron, their departures from Curie's law were greatest but there seemed to be a tendency to obey it. My results show that not only is the law not obeyed but that the small curvature which does exist is in the wrong direction. Delta iron was beyond the limit of their apparatus. Experiments on magnetite which are now in progress, show that for this substance Curie's law is not even approximately obeyed.

From these results it must be concluded that it is impossible to ascribe to the atom of iron, nickel and cobalt a definite number of magnetons dependent only upon the allotropic form of the metal; but that there must be continuous changes in the atomic magnetic moments as temperature is varied. Whether or not sufficient evidence is given here to overthrow the magneton theory entirely may be open to question, but certainly if this theory holds at all, one would expect it to hold for these substances which, magnetically, are most important.

THE RELATION OF DISTRICTING TO PUBLIC IMPROVEMENTS AND REAL ESTATE VALUES.

Sidney J. Williams, g. '08, C. E. '15
Inspector, State Industrial Commission

(A paper read before the Wisconsin Society of Engineers)

By public improvements is meant streets, boulevards and parks, water and sewer systems, and city and county buildings. By districting is meant the division of the city into districts, sometimes called zones, and the establishment of different regulations concerning the size and use of buildings in different districts. New York City, for example, is divided into residence districts, business districts and unrestricted districts, and then into districts with respect to the height of buildings, the limit ranging from two and one-half times the street width in the Wall street district, to the street width in the suburbs. Finally, the size of courts and yards is also regulated by districts, being much greater in the outskirts than downtown.

Districting is one element of city planning. Suppose our city planner, whether he be city engineer or real estate operator—for every city engineer and every real estate operator is a city planner, good or bad, whether he knows it or not—carefully lays out a new residential subdivision, with rectangular blocks, one or two wide thoroughfares, and narrow cross streets, all according to the most approved methods; suppose he puts in water and sewer mains of proper size, a few hydrants, macadam pavements, trees, everything that is fitting for a residential district. Presently a new industry comes to town, attracted by a bonus perhaps; searching for cheap land, it buys half a block or so in the new subdivision, and proceeds to manufacture chairs, or mattresses, or gas engines, or perhaps to slaughter cattle or to pick rags. If the new industry grows, or if others settle near by, then indeed the city planner's dream becomes a nightmare. The narrow streets, ideal for residence, are too narrow for industry; the pavements are ruined by trucking; the water mains are too small for proper fire protection and the sewers inadequate for industrial wastes; the spacious but neglected boulevard running between coalyards and warehouses is incongruous if not absurd.

The effect on real estate values is even worse. The man who has scraped and pinched to buy himself a lot and build a house upon it, finds his property depreciated fifty per cent by the foundry or packing plant, or even garage, which settles uninvited at his elbow. Perhaps he may ventually sell his house at a profit to some other factory; but this possibility is small and remote, and meanwhile he eats and sleeps to the accompaniment of steam hammers or automobile horns, and curses his own thrift and the real estate man's eloquence which led him to make the investment. Some operators have tried to prevent this by placing restrictions in the deed. This is at best only a partial remedy, because the courts have not satisfactorily determined just how far such covenants will hold, and because later, when the growth of the city makes it really necessary to change the character of the district, dead men's signatures may prove a serious obstacle to legitimate progress.

Thus we see that where the character of a district is liable at any time to be radically changed at the uncontrolled fancy or selfish interest of an individual, there is great damage both to the city's investment in streets and other improvements, and to the private owner's investment in residential property.

The uncontrolled height and size of buildings do as much damage as their uncontrolled use. On a quiet residence street, built up with detached houses, the advent of a huge apartment building is often as serious as that of a factory or business block. It is true that we have state regulations as to the minimum size of courts and yards for light and air; but these regulations were based on conditions in the congested districts of Milwaukee, where land is very costly, and when applied in the suburbs, or in a smaller city, such regulations are useless, or even worse than useless, because the owner naturally builds up to the legal limit, and thereby builds far beyond the limit sanctioned by common usage in that locality. The only remedy is district regulations which will, as far as is reasonable, conserve the prevailing character of each district until the growth of the city necessitates a change.

It may be claimed that these things regulate themselves automatically—that when a property owner risks his money by building a factory or an apartment house in a residence district, his action proves that such new development is in fact necessitated by the city's growth. But this argument is fallacious. It is an established fact that the first apartment house in a residence street, or the first high office building, is generally a paying investment, because it is able to steal light and air from the neighbors, and because it is a new thing, and because its occupants enjoy the view of handsome residences and well kept lawns on all sides. But let this building be surrounded by others of its own kind; all these advantages disappear, and neither the original invader nor its imitators is profited. Thus it is a positive advantage to the operator to put up the first large building far in advance of the real needs of the locality; but for every dollar of profit reaped by his enterprise, at least a dollar is subtracted from the salable value of neighboring property. Therefore we arrive at the principle that in any locality no building should be permitted which will not serve as a suitable type, both as to height, size, and use, for the development of the entire district. Any departure from this simply means that one owner is profiting at the expense of others.

Emphasis should be placed on the effect of uncontrolled building upon the public health, safety, and welfare. It is clear that lack of light and air, and yards for children to play in, is detrimental to heath. Street congestion is dangerous to safety and health, increases the cost of doing business, and decreases fire department efficiency. I shall not dwell on this. After all, if a householder of moderate means, who cannot afford fads and fancies, is willing to sell his home for half what it cost him, because of an unexpected change in the character of neighboring buildings, is not that the best possible proof that such change does threaten the health, safety, and welfare of his family? And are not that householder and his family, entitled to protection against that danger, just as much as against the danger of burglary or fire?

I have stated it as a fact that uncontrolled building often depreciates neighboring property values. I do not think any real estate man will question that statement. If anyone else questions it, he should read in full the testimony of Mr. Lawson Purdy, who, as president of the Board of Taxes and Assessments of New York City for ten years, heard some 50,000 applications for reduction of assessments, a large part of which were based on the erection of buildings adjoining, which were too high or covered too large a portion of the lot. Mr. Purdy tells of a single block for which, in five years, the assessment had to be reduced from $17,000,000 to $7,000,000, because of the intrusion of factories into a high-class retail district. He tells of similar cases all over town; and as a result of his experience, he became one of the strongest advocates of a districting system for the city. I wish that any city engineer who is inclined to be skeptical might talk with Nelson P. Lewis of New York, perhaps the foremost municipal engineer in the country, who tells convincingly how impossible it is to lay out a satisfactory street system when one does not know what kind of neighborhood the streets are to serve. It is true that there is "only one New York," but it is also true that what has happened on a large scale in New York, has happened and is happening on a smaller scale in every city, and will happen more and more each year until we stop it. The small town of today is the big town of tomorrow. If today the small town does not take steps to protect itself, tomorrow the big town will find it too late. It is common nowadays for large industries to locate in towns of ten, twenty, or thirty thousand people, where land and labor are relatively cheap, and such industries generally have little regard for the rights of their neighbors. Furthermore, small cities, as well as large, build city halls and other public buildings, and should have something to say as to their environment. Imagine spending public funds for a splendid auditorium, and then seeing a blacksmith shop establish itself on one side, a planing mill on the other, and a junk-yard across the street!

How to stop such things, then, is the question. Germany and England have stopped them for many years. In this country there have been scattered attempts, more or less intelligent, more or less successful, never very comprehensive. Minneapolis and Los Angeles have residence districts. Baltimore and Indianapolis have established special height limits around special squares. In Boston and in Washington, D. C. there are different height limits for different districts. The first comprehensive districting system is that adopted by New York City last July, to which I have already alluded. This includes the entire city and covers the use, height, and bulk of all buildings hereafter erected. The plan was worked out with the greatest care, by a special commission of seventeen members, including leading architects, engineers, real estate operators, lawyers, and other representative business and professional men, with a consulting expert and assistants. Two years were spent at the task, and innumerable meetings held with groups of interested citizens. As a result, the final plan received almost no opposition and was adopted with but one dissenting vote. All details are contained in the city ordinance, for the state law is very general in its terms. Both the city ordinance and state law have been attacked in the courts as unconstitutional, but no dedecision has as yet been rendered. If a layman may venture to express an opinion on so sacred a subject as constitutional law, I would say that the decisions of the United States Supreme Court in the Los Angeles, Boston and other cases, indicate that the New York law will be upheld.

In Wisconsin a bill was passed in 1913 permitting cities to establish residence districts. Under this law Milwaukee established several such districts and Kenosha also established one. Unfortunately this law, instead of being based purely on police power (i. e., the power of state and city to protect the health, safety and welfare of the people) includes also an element of condemnation, in that property owners are permitted to sue for damages resulting from the establishment of such districts. The law also has other technical defects. Therefore when Milwaukee was threatened with a number of damage suits, on the advice of the city attorney it repealed its ordinances.

This year a bill has been introduced in the legislature by Senator Bray of Oshkosh, which aims to correct these defects and give us a workable law. This bill repeals the present unsatisfactory law and creates two new sections modeled after the New York law. Broad power is given to cities to create districts and to make such regulations as are deemed necessary regarding the use, height and bulk of buildings hereafter erected in such districts. Any city which desires to establish such districts must first have a city plan commission organized according to a law already on our statute books. Such commission, according to the proposed law, is to consist of the mayor, the city engineer, one alderman, the president of the park board, if there is one, and three citizens, all serving without pay, and acting as an advisory board to the council on everything concerning city planning. In Milwaukee the public land commission takes the place of a city plan commission.

According to Senator Bray's bill, the city plan commission, or public land commission, must first formulate a tentative districting plan, hold public hearings thereon, and finally report to the common council. The council may amend the report, but only after public hearings on the amendments. This protects the property owner against hasty or uninformed action by the council. As the city grows, the boundaries of districts, and their regulations, may be altered; but if the owners of twenty per cent of the frontage affected object to such change, it may be made only by a three-fourths vote of the council. This protects the owner against frequent or unnecessary changes.

The Milwaukee council, public land commission, and civic organizations have already expressed themselves as favoring a law on this subject, and will doubtless support Senator Bray's bill. Influential citizens in Milwaukee and Madison and, it is to be hoped, the Madison city council, will support it. A few incurable pessimists will no doubt oppose it on the ground that it is something new and that it interferes with the free-born American's sacred right to do as much damage to his neighbor as he pleases. But the latter argument is not very popular nowadays, and the former is not true. This is not an untried experiment. In Europe it is an old, old story. Parts of it are an old story in various American cities. Every city in Wisconsin has fire limits, and fire limits are simply one form of district regulation. Conservative New York adopted its present plan after four years of careful consideration, and after six months' trial seems well satisfied with its choice. The *American Architect* reports that in the Murray Hill residential section there are only sixty per cent as many vacant houses as there were when the law went into effect and that "residences for many years vacant are now occupied" and "buildings on what had heretofore been retail streets, but which have stood vacant for a number of years, are being remodeled for tenants who can no longer look forward to the possibility of locating in a residence district where their gain would be the neighborhood's loss.'' In other words, the law has done exactly what it was intended and hoped to do.

It is hoped that the legislature will vigorously support the pending bill. The action of the legislature depends largely upon the demand for the bill as shown at various hearings. Should the bill become a law, it is urged that every citizen strive to have his city make use of it by passing a well-considered districting ordinance.

THE UTILIZATION OF WASTE SULPHITE LIQUOR

K. S. McHugh

In the manufacture of cellulose products, especially of paper, there is a gross waste of raw materials. In the manufacture of paper by the sulphite process, a large part of the pulp is dissolved in the cooking and disappears as sulphite liquor. This waste is an economic question of great importance, and the disposal of the liquor becomes a serious problem because of the pollution of streams and watercourses into which it is discharged. In this country alone, the United States Geological Survey [1] has estimated that an annual total of over three billion gallons of sulphite liquor is discharged into streams. The question of the utilization of this liquor has accordingly been one of deep interest, and a great deal of work has been devoted to the solution of it.

An average liquor contains:[2]

Sugar (as dextrose)	2– 3.3 oz. per gallon.
Other organic materials.....	10–13.3 oz. per gallon.
Inorganic material	1.2– 1.9 oz. per gallon.

The other organic material consists principally of lignin, together with small amounts of hydrates, fats, resins, and protein. The sugars are principally the fermentable sugars, dextrose, laevulose, mannose, and galactose, and it is these which form the basis for the greater part of the work which has been done on utilization. Various processes have been invented to convert these sugars to alcohol, and since this is the most important and valuable product, the utilization of the other materials has been made subsidiary to it.

Only two methods for the production of alcohol have had any extensive commercial application, that of Wallin and Eckström[3] in Sweden, and that of Landmark[3] in Norway. The Wallin and Eckström process is in use at the plants of Stora Kopparberg's Stock Co., and in Bergvik, Sweden. In this process the

[1] Jour. Ind. and Eng. Chem. 8:102. A. D. Little.

[2] Liebig's Annalen der Chemie 267:341. J. B. Lindsay, B. Tollens. Translated by F. W. Kressman. (F. Prod. Lab.)

[3] Tidsskrift for Papirsindustri. Mar. 15, Feb. 15, '15. H. B. Landmark. Translated by M. C. Jensen. (F. Prod. Lab.)

free sulphur dioxide, which is always present due to the sulphiting of the pulp, is neutralized in the warm liquor with precipitated lime from the sugar factories. Finally milk of lime is added to insure complete neutralization. A specially prepared yeast is added and complete fermentation results in five or six days. The alcohol, which is removed by distillation, amounts to as much as 0.7 to .95 per cent in this process.

In the Landmark process, the liquor is first evaporated to expel the free sulphur dioxide and the residue is then carefully neutralized with calcium carbonate, and fermented. It is claimed that this method does away with the harmful action of calcium salts on fermentation as much less lime is needed than in the Eckström process. A small amount of hydrolized milk sugar or whey is added to increase fermentation, the ordinary brewers yeast being used as a ferment. The process of fermentation is complete in four or five days and after distillation yields 1.1 per cent of alcohol by volume. The actual yield is 55 cc. of absolute alcohol per 100 grams of sugar, as compared with 45 cc. per 100 grams by the Eckström process. The cost of production in the Landmark process, including upkeep and amortization, is 2¼ cents per liter (8½ cents per gallon), as compared with 15 cents per gallon by the Wallin and Eckström method. The present production is approximately a half million gallons annually.

After distillation of the alcohol, the residue is further utilized. It consists principally of lignin, together with small amounts of other organic and inorganic materials. The separation of the valuable lignin from these substances was perfected by Strehlement of Sweden and later used in connection with Landmark's process. Sulphurous acid is oxidized to sulphuric acid by passing air into the solution under pressure, whereupon the lignin precipitates out and is filtered off. The remaining materials may be obtained by evaporation of the filtrate to dryness. The product, known as zellpeck, when made into briquettes with coal dust has a calorific value about one-half that of coal and is used as a fuel. Various products are obtained from the lignin by dry distillation, chief among which are acetone, acetic acid, tar, and ash fertilizer. The total value of the products obtained from one ton of waste liquor by the above process is $12.87, at current prices.

Another process patented by Landmark [1] is a method for the production of tannin extract from sulphite liquor. The details of this process are not available, but a plant is now in operation at Embrets Falls in Norway. The production is approximately a million and a half gallons annually and will be increased. Samples of this extract have been tested in several large tanneries with very satisfactory results.

In the United States, paper manufacturers have been very slow to take up the work of utilizing waste liquor, which has been and will continue to be a source of economic waste and stream pollution until there is a united effort on the part of mill owners to work out this problem. At the Agriculture Experiment Station in Oregon,[2] some experimental work has been done on the production of alcohol from sulphite waste. The method employed is approximately the same as Landmark's, the yield being one per cent of alcohol by volume. As yet, however, it has not been established on a commercial basis, although there is some chance of the coast mills' going on with the proposition. A variation of the above process was started in Louisiana. Waste pulp was hydrolized with acids to form fermentable sugars, and alcohol in turn was obtained by yeast fermentation. The concern later became insolvent, but it has been claimed that the failure was due to poor business management rather than any fault in the process.[1] A process patented by the Robeson Co., of Pennington, N. J.,[2] makes use of the treated liquor as a road binder. No details are available, but it is known that the lignin is here the active substance. The liquor has also been used to some extent in foundry practice as a binder in core making. Aside from the few uses mentioned, sulphite liquor is still a tremendous waste in this country. The government Forest Products Laboratory is at present working on the problem, and it is to be hoped that there will be soon forthcoming an answer to this perplexing question of sulphite liquor utilization.

[1] Tidsskrift for Papirsindustri. May 1, 1914. H. B. Landmark. Translated by M. C. Jensen. (F. Prod. Lab.)

[2] Jour. Ind. and Eng. Chem. 8:226. Tartar.

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THE POWER TO VISUALIZE

EDWARD BENNETT
Professor of Electrical Engineering, University of Wisconsin

It was the writer's fortune to spend four years in engineering work in the mountainous districts of Utah and Idaho. From the hydro-electric stations located along the canyons it was but a few miles to mountain peaks rising to elevations of two miles and over. It goes without saying that the trips and excursions back into the mountains and over the divides from one valley to another were an unfailing source of peasure. Among the most delightful moments of that experience, were the occasions when, in the course of excursions away from the beaten trail, points of vantage were attained which gave a particularly good bird's-eye view of the surrounding country. In front was spread out all the district; entire trails and their cross connections could be seen. The proportions were in many cases seen to be entirely different from what they appeared to be in the journeys along the trails, and many a thing which had formerly been a puzzle was made clear.

One may have two types of knowledge of a country: first, the kind of knowledge one obtains from traveling along the lowlands, seeing at any one time only a small section; and, second, the kind of knowledge one obtains in viewing the country as a whole, as from a mountain peak. In the intellectual world there are analogous ways of seeing the relations between things. In general, we have before us only a small portion of the whole picture. However, at times and for brief intervals it is possible to attain vantage points from which we may obtain a view of the whole district; not a view of the entire universe, but a view, let us say, of a whole county as contrasted with a view up and down the trail for a mile or so and on either side for a few hundred yards.

Our habits of thought are comparable with the mode of learning about the country by travelling along the trails and getting, at any one time, a view of only the immediate surroundings. That is to say, in the solution of any involved engineering problem, we obtain a general idea of the direction and start out to follow a promising trail. The first trail leads either to a point from which it seems either promising to go ahead, or advisable to turn back and start afresh. In this whole process, we get only a piece-meal view of the path. Throughout the process, we are greatly dependent upon mechanical aids to thinking. We must have before us a diagram of the circuit or a drawing of the structure; we must write down the steps and the conclusions which form points from which a fresh start is made. Throughout the whole investigation we find it extremely difficult to get the bird's-eye view of the intellectual field which is analogous to the bird's-eye view from the mountain top. This brings me to my subject, *the power to visualize the problem as a whole,* the power, at some stage, to throw away the diagrams, the pencil and the paper, the power to close the physical eye and to see clearly with the mind's eye the whole field at one time.

This power to visualize relations in their entirety is not wholly a gift. It is rather a faculty to be cultivated. The power of visualization may come from, or grow out of, the habit of meditation. How many of us have formed the habit of meditating upon the things which concern us? True it is that we sometimes concentrate; we seize upon the tools and materials at hand and drive through to a serviceable conclusion, and we are content. But from the vantage ground of the conclusion, do we take the time either to look around or to look back over the ground? Concentration is *an aspect of* meditation, but it is not meditation. What, then, do we mean by meditation? What should be the mental attitude or the frame of mind during such a period?

In the first place, a period of meditation should follow at the close of a long period of work. After a period of work with mechanical aids, one should put away the books, the notes, the sketches, and the reports; he should exclude or attempt to exclude all distracting influences, and for at least a brief period should turn the problem or the project over and over again in his mind in order to examine it from all sides and in all its bearings. This advice is very vague; in particular the counsel to view a thing from all sides is very indefinite, since, as a rule, one sees only that for which he is looking. Can we not be more specific? How shall we look? What shall we look for? It has seemed to me that meditation includes three distinct ways of looking at things. We ought to assume, at different times, three distinct attitudes: (1) the questioning attitude, (2) the critical or iconoclastic attitude, and (3) the receptive attitude.

In the "questioning attitude," we make use of our conclusions and data at their face values. We ask all sorts of questions intended to bring out the surface relations and connections of the subject under consideration, but we are not overly critical. We make no attempt to examine the subject or test the conclusions in the light of first principles. As an example, when we encounter Newton's Third Law of Motion—namely, "action and reaction are equal and opposite in direction"—in this questioning attitude, and put to ourselves the question, "Where have I seen something like this before?" we should probably say to ourselves, "Why! this is double entry bookkeeping in physics, is it not?"

In the "critical or iconoclastic attitude" we have no respect for anything, it matters not how self evident nor how hoary with age it may be. When we offer the extremely lucid and almost self-evident explanation: "The iron became saturated and its hysteresis gave rise to higher harmonics (principally the third) in the ionization which led to resonance between the armature reaction and the field excitation; by *resonance,* high frequency oscillations were set up in the efficiency of the insulators, and the surge which followed broke down the synchronous reactance of the energy zone," we are not quite satisfied with it. We raise the inquiry as to what the explanation means, and we proceed to try to determine what it may mean by applying the notions to a transformer instead of to a generator. We find they apply equally well. It begins to look as though we have hit upon a valuable formula, but we are not content. We apply the formula in steam engine design, and it seems to explain; but we keep on, and we find it applies equally well in all fields, and it means—nothing. This is the beginning of wisdom.

As another illustration of this critical mood suppose that a traveler at night should be contemplating that great dominating generalization of physics—the doctrine that the amount of energy in the universe is invariable—and suppose that a particularly bright street lamp should at the same moment force itself upon his attention. If he were in the critical mood, and if his thought should dwell for a moment upon our conception of radiant energy streaming from the lamp off into space, travelling on and on and absolutely lost to our measurements, might he not call the manner in which we reconcile the thought of the lost energy (lost to measurement) with the doctrine of the inavariableness of the amount of energy, a subterfuge?

The third attitude is the "receptive attitude." The statement has already been made that in general one sees only that for which he is looking. And yet in this connection it ought not to be forgotten that after mankind had been exposed to the sight of falling apples for untold generations, one man—Newton—finally saw an apple fall. And so, I think that if we only learn to keep the eyes of the mind open and directed in the proper direction, we will at times, and purely and simply by accident, see things that have hitherto escaped us. To do this, we must look at things not necessarily in a questioning or in a critical frame of mind, but more leisurely, and for longer periods, and with greater interest.

ALUMNI LETTERS

TEN YEARS OUT

F. E. FISHER, e. '06
*Designing Engineer, Diehl Manufacturing Co.,
Elizabeth, N. J.*

FROM DESIGNER TO SALES ENGINEER

It seems a remarkably short time since I climbed the old hill to eight o'clocks, and I can hardly realize that I am an "old grad." When I was introduced to a 1915 man at the New York-Wisconsin luncheon a few weeks ago I was shocked into a realization that I have been out more than ten years.

Many interesting experiences have come my way during that time, although I have been in the services of only two companies. When I joined the "guessing stick brigade" in 1906, and began punching the time clock at the Northern Electric Company as a member of the engineering department I was put on government work. Since then I have been a designer of direct current machines, many of which have been for the United States Navy. I was handicapped in the beginning by a lack of shop experience and when I changed positions in 1909, I decided to take an apparent step backward, retired from a white-collar position and accepted a 7 A. M. to 6 P. M. with forty-five minutes for lunch job as test floor foreman for the Diehl Manufacturing Co. The shop experience came fast and hard, for pushing a pencil and slide rule are not conducive to muscle building. The work, however, was very interesting, but not exceedingly remunerative. It afforded frequent opportunities for using my head in more ways than one. The company was just beginning the development of government apparatus. Orders came in rapidly and there was room, after two years, for me in the engineering department.

Government specifications were, and still are, very strict and I have had the opportunity and pleasure of designing satisfactory equipment for Uncle Sam's navy and assisting in the development of new apparatus, such as electrically driven steering gears, turret turning, gun controlling and ammunition handling equipments, turbo-generators, etc., for battleships, and main motors and auxiliaries for the very interesting and now popular submarine.

During the past three years, I have had more of the commercial side of engineering, made necessary by the development of electric vehicle motors, dynamometers, etc., which depend for their sale more upon the engineering features than does standard apparatus.

The salary of a designing engineer is limited and advancement in position and salary must be secured in the commercial or business end. Chief engineers' positions, paying good salaries, are comparatively few. Sales engineers, on a commission basis, seem to be the real "coin collectors."

It would be interesting to know how many engineering graduates of Wisconsin of the last ten years are doing strictly engineering work. I would probably come under this class until May 1 next, when I shall move my family to Chicago and take a position which is more in the nature of a sales engineer with the Goodman Manufacturing Company of Chicago. I am looking forward with pleasure to seeing more Wisconsin men, for there are comparatively few around Elizabeth.

My experience with and observation of Wisconsin graduates leads me to the conclusion that good old Wisconsin prepares her sons as carefully and thoroughly as any institution in the country.

I send cordial greetings to all Wisconsin men, particularly the "old grads" of 1906.

NINE YEARS OUT

ALBERT J. GOEDJEN, e. '07
Assistant General Manager of the Wisconsin Public Service Co., Green Bay, Wis.

ENGINEERING EDUCATION NOT COMPLETE IN FOUR YEARS

With a country school beginning and later with rather a modest high school education in a town having limited material of engineering interest, it was somewhat of a blind decision which lead me into the engineering course of the University of Wisconsin. Although I rejoice greatly in my early decision, I feel that it was much like joining a secret society—deciding first, and learning about its possibilities later. A general lack of understanding of the engineering profession allowed me to entertain a vision, while in high school, of becoming a highly proficient engineer in four years and of being ushered at commencement into a very lucrative position. At graduation from college, however, the lucrative position was not waiting, and the engineering education was not complete, as I had once expected. Instead, a very modest position with an excellent opportunity to learn more presented itself. I appreciated the opportunity it offered and accepted the position.

Since then each year has brought out more clearly in my mind the fact that a college education is not in itself a guarantee for the future, as I had once considered it. Instead it is a wonderful means of developing the character and greater mental power wherewith, by wholesome thought and untiring effort, the substantial and durable satisfactions of life may be achieved.

EIGHT YEARS OUT

E. P. Abbott, c. '08

Engineer, A. Guthrie & Co., Inc., Railroad Contractors, Blue Island, Ill.

ACCURACY

The average young engineer, just out of college, will learn if he has not already discovered it, that he is woefully deficient in at least one respect. That is accuracy. If more attention were paid to the acquirement of precision in one's engineering work, far more beneficial results would come.

Accuracy is not a gift; it is something that has to be acquired; and the sooner a man makes up his mind to be accurate in his work the sooner he will save himself many an embarrassing and often costly error. An engineer should acquire the attitude that it is a disgrace to be caught in a "bull," which is the term by which careless errors are so commonly known.

The writer was no exception and blundered along for more than four years until he went to work under a man, a Wisconsin graduate, who had trained himself until he was known for his accuracy. This man would not tolerate the careless errors that the average man makes, and whenever he discovered a man had made a "bull," the whole force knew about it. It was most embarrassing to be severely reprimanded before the whole office force, but it had its good results, and the writer can now look back on that training as one of the most valuable experiences.

SEVEN YEARS OUT

W. B. Bassett, e. '09
Commercial Engineer, Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.

ADVICE FROM A STUDENT COURSE GRADUATE

At this time of the year, each senior student of engineering is interested in knowing what he is to do after graduation. It is true, some may have entered the university with a definite position in view; but with the majority, this question is not decided until after the second semester begins.

In the spring of 1909, a representative of a large manufacturing concern visited the university to interest the senior electrical engineers in the apprenticeship department of his company. He left with a number of applications, one of which bore my signature. My decision was influenced by the realization that I did not know what was required of one to fill a responsible position. I needed that practical experience which inspires confidence. The broad field covered by the Westinghouse Electric and Manufacuring Company appealed to me. I felt that if it were possible to make good in the electrical profession, a course of training such as this concern offered ought to open the way.

My first real work in the course was to tear down a small distributing transformer, which you will recognize as a meager operation for one who has taken a four years' course in engineering. An ordinary laborer, with a very limited education, could have done the work better and much more quickly. However, there is no better way to learn the troubles to which transformers are subject than to hold a post-mortem examination, which is as necessary with transformers as with the human body. This applies equally well to other types of apparatus. The knowledge which my instructors at the university succeeded in pounding into my head enabled me to analyze the troubles and in some cases to suggest methods of preventing their recurrence.

My interest in transformers was soon noticed by the foreman of the section, and in a short time my duties were confined to the inspection of transformer manufacture to see that the various operations conformed to the prescribed standard. This type of work extended over a three months' period.

For the following four months I tested large motors and generators. This work was very instructive, as it afforded an opportunity to compare the working condition with the theory and arrive at a practical conception of electricity. The large variety of apparatus, including A. C. turbo-generators, A. C. and D. C. generators, rotaries, motor generator sets, synchronous and induction motors, gave me a fairly good working knowledge of the operation of the various types of machines. My only regret is that the time I spent at this work was so limited.

Early in the apprenticeship course, the decision as to what field of endeavor to enter presented itself. The commercial work appealed to me. Following this lead, the course has taken me through the Negotiation and Order Departments to the Price Division. It is the duty of the latter to follow the price situation, which necessitates the close combination of internal shop costs and outside market conditions. The development of new apparatus to meet more exacting demands is closely allied with shop costs and prices and involves consideration by this division. After a thorough study of the demands of the buying public, the price which can be obtained, and the cost at which the product can be marketed, recommendations as to what apparatus shall be developed are made Any case may involve a choice of several plans. Your company's success depends upon the decision. After the development of any particular branch is started, it is followed through the Engineering and Works Departments, both in the experimental and manufacturing stages, until it is ready to be placed on the market.

Looking back over the past eight years, I am moved to offer the following advice:

Master the English language. There is no greater asset to advancement in any line than the ability to understand composition and to express one's self correctly and precisely. Many a good report is rejected or delayed because of faulty construction, which prevented the "boss" from grasping the "big idea."

Get a thorough knowledge of shop work, even if you find it necessary to spend more time than you originally intended. A great many problems in electrical engineering are of a mechanical nature and shop experience aids materially in solving these problems.

Learn the correct use of the telephone. This little instrument is a time-saving device if correctly used. I have seen cases where the tone and manner of conversations were such that the party at the other end of the line became impatient and hung up the receiver. Such action necessitates a personal visit to right the difficulty. It takes diplomacy to carry on a successful conversation over the telephone.

Finally, go to the bottom of things and get all of the facts before drawing conclusions; first impressions are often incorrect.

SIX YEARS OUT

J. C. Pinney, c. '10
Superintendent of Bridges and Public Buildings, Milwaukee, Wis.

THE ENGINEER IN POLITICS

A discussion of what is expected of an engineer in the municipal service, occupying what many call a "political job," resolves itself into the much discussed question of "The Engineer in Politics." In the first place I wish to say that I am much opposed to the engineers entering politics as that word is so commonly used. Using the broader and more correct meaning of the word politics, i. e., the body politic which is comprehensive and includes all our forms of government, I will say that the engineer, as well as all other specially trained men, has a very distinct and useful field, a field which calls for his services and in which he has a definite duty to perform for the community. The municipal engineer is serving the community as an employe of one or of all of the representatives elected by the people. He is therefore directly responsible to a political body, many of the members of which are of the ordinary political type. In this unpleasant position he is often tempted to play the game of politics himself. If he is called upon to make certain recommendations or to give certain advice to this political body, he very naturally is desirous of having his advice followed. This perfectly natural desire of the engineer should under no circumstances be allowed to alter or shade his recommendations or actions in order to secure the approval of this political body. Throughout his work he should have at heart the best interests of his community.

The two main influences that are most destructive to municipal efficiency are : (1) political influence often presented in the form of pressure brought out by large taxpayers and (2) the desire of the engineer to do those things which he thinks will result beneficially to his personal reputation rather than to the community. In considering the first of these influences it must be remembered that the very foundation of our government is one of co-operation rather than corporation. The man who pays a million dollars in taxes should have no more legal voice than he who pays but one dollar. As for the second, it need be merely said that in the end a man's reputation will be judged not so much by the monuments he has built to himself, as by the conscientious service he has given to his employer, private or municipal.

Municipalities of today need professional men of training, men who are competent to advise and properly direct their affairs, men who will stand opposed to those influences which work against the best interests of the municipality. The engineering profession has furnished thousands of this type of men and must continue to do so.

FIVE YEARS OUT

K. R. HARE, e. '11
Associate Editor, Railway Electrical Engineer, New York City

FUNDAMENTALS

The soundness of the faculty's stand that a college or university engineering course should attempt to treat thoroughly only the fundamentals of the various engineering subjects, instead of trying to perfect a student for any one particular line of work, has been a growing conviction in my mind. I know from experience that this view is not always, and I think that I can safely say, not usually held by the engineering students themselves, who, at the time, perhaps have their eyes on some special field of activity and think that it would be to their advantage if they could specialize in that particular branch of engineering at the university.

For myself, I thought while at Madison that I would certainly go into hydro-electric work and I used to feel impatient because I had to spend so much time on what seemed to me irrelevant subjects such as storage batteries, chemistry, analytical geometry and even English. Since graduation, however, each day has made clearer to me the fact that the best policy is to master the fundamentals of the various engineering subjects while at the university with the idea that the detailed information relating to the application of these principles can be quickly obtained after graduation. In the four years which are spent at the university it is not possible to do any more than thoroughly cover fundamental principles and even if a student, through some force of circumstances, knew exactly what work he was going into, he would still receive the greatest benefit from his course if he were content to master the fundamental principles of engineering.

It has been my experience that university graduates make a serious mistake if after graduating they go out looking for a job feeling that they know all about the subject. A man will usually make a better impression when he first gets out of school if he will keep the fact that he is a university graduate, in the background, instead of putting it forth as a reason why he should be given preference. Universities simply fit the man so that he can absorb with the least effort the information necessary to advance in a certain work with the greatest possible speed, providing he puts his heart and soul into it. When a man leaves the university he is, for all immediate purposes, on the same level with the high school graduate who started in actual practice four years previous. However, the man who has had the advantages of the university training will find that for the same application of energy he will overtake the practical man in a year or two. After the practical man has reached a certain point he rarely can progress much further.

The first two or three years after graduation afford the time necessary for the engineer to gain a knowledge of the practical application of the principles which he learned in school. During this time he will make many changes simply because of the salary and practical advantages offered.

I followed the above program to a certain extent myself. After graduation I worked with the General Electric Company in the test department for about a year and then as I desired work in a hydro-electric company, I accepted a position with the Great Northern Power Company in Duluth. It was not long, however, before I learned that the Northern Pacific Railroad was looking for a man to take charge of its electrical department. The position required some knowledge of all kinds of electrical construction work from the wiring of buildings to the installation of electric power plants, as well as a knowledge of electric car lighting and the installation of shop motors. Because of the experience that I had had during the summer vacations and because of the work I had just done, I felt confident that I could handle the job, and accepted it. After I had been with the Northern Pacific for three years I was offered a position with the *Railway Age Gazette* and the *Railway Electrical Engineer* and again it was either jump or be left behind. I appreciated the opportunity and accepted my present position.

Such changes can be safely made during the first few years even though an absolute change in the kind of work is involved. Nevertheless there is a certain danger in changing around too much. A man should plan to settle down in a definite field of work during the first three or four years of work so that his experience in that work will enable him to advance steadily to the higher positions. In other words, it is a poor policy to get into the habit of accepting any new work that offers itself simply because it offers an increase in salary. A continuation of this policy will result in a smattering knowledge of everything but a sure knowledge of nothing. Find yourself in the first three or four years and then stick to one thing.

I should not neglect to mention the fact that the longer I am out, the more I am impressed with the prestige that the University of Wisconsin graduates have all over the country and I believe it is a sacred duty of both the students and faculty to maintain this feeling. The faculty can do this by rigidly maintaining a high standard of work and enforcing the rules regarding the grading of work; and the students can do their part by conscientiously doing all the work that is assigned to them, not with a feeling of resentment because it is difficult, but with a determination to master it at all costs.

FOUR YEARS OUT

A. W. QUAST, m. '12
Auditor, The Fulton Co., Knoxville, Tenn.

ADVICE FROM A COMMERCIAL ENGINEER

Although, in looking back through the four years since I graduated, I can see hours and days of work that I would not care to live over, the experiences of those years have paid good dividends. I often wonder how it was possible for me to endure some of the difficulties which I encountered.

When I left the strictly engineering field and accepted my present position as auditor of a fair-sized manufacturing establishment I followed a very definite plan. I had several reasons for choosing the field of cost accounting and auditing. The principal ones were: (1) because it was a new subject, (2) because it seemed a stepping stone to the manager's chair, and (3) because I thought it suited my ability.

In this connection the following advice may be of value:

Don't ask your employer for something if you have reason to believe you will not get it.

Give him more than he asks for.

Don't try to hurry him, or try to force your opinions against his wishes, even though you think you are right.

Don't be afraid of a little overtime.

In order to obtain a good position follow some course of study. In order to keep your position study the work you are doing; read all the books and magazines referring to the subject that you can obtain. Plan each day's work, each week's work, and so on, depending upon your ability and thoroughly master each assignment.

THREE YEARS OUT

E. A. Jacob, c. '13
Resident Engineer, Sevier River Land & Water Co.,
Synndyl, Utah

LEARN TO USE YOUR HANDS

We see many men at the top in the engineering profession who have worked up from the bottom without a college education. They mastered the use of the tools with which they worked from the level rod and stakeman's ax to the manager's quill and stamp. Their technical education was secured by study and by contact with practical work, their social education by contact with men.

Many graduate engineers leave school with the notion that they should at once become designing engineers; or if the ideal is not quite so lofty, they do expect to accomplish in a short time something of importance in the field of engineering. I have worked with graduate civil engineers who could not run out a line of levels and check back, and others who, if given some drafting work to do, would mutilate the maps almost beyond recognition. I might add by way of parenthesis that the graduates I mention were not from the good old U. W., and I trust there will be none such. It is scarcely probable that the new graduate will be asked to design an important bridge or dam, or be called upon for professional advice in a consulting capacity in the first few years.

A frequent criticism of engineering graduates is that they are not thoroughly trained in the fundamentals of engineering from the practical viewpoint. This criticism is a just one in too many instances.

The engineering student should become more familiar with the instruments and machines he will use after graduation; should learn to use his drafting instruments, transit and level, slide rule and planimeter, but above all should accustom himself to using his hands as well as his head, for if he cannot use his hands he will not likely be given a chance to use his head.

TWO YEARS OUT

WALTER P. BLOECHER, c. '14
Assistant Resident Engineer, B. & O. R. R., Curtiss Bay, Md.

SELECTION OF ELECTIVE COURSES

I am happy to respond to the request of your editor for an alumni letter, although you are asking for something real when you talk of advice. A thought in my mind which deepens as the time goes on is the really artificial boundaries of engineering which you in the university are prone to observe. I refer to the distinctions made between civil, mechanical, electrical, chemcial, and what-not, engineering. Did you ever stop to think how few engineering feats have been accomplished by applying only the principles involved in one of these branches?

I have been engaged for three years on several large pieces of railway construction work as a civil engineer; and while this work has been fundamentally of a civil engineering character, it has invariably embraced considerable power plant and electrical machinery installation. Many times have I wished for a better knowledge of electrical engineering or for more "steam and gas." Everything that isn't dead moves; it takes power to produce motion, and therefore power is the life and blood of all modern engineering creations. To neglect its study puts one in the class of non-movable things.

And lest the mechanicals and electricals think that they have it on the civils, let me remind them that all their engines and generators must have buildings, their smoke stacks need foundations, their locomotives need bridges, and their hydro-electric plants need dams. So it behooves them, too, to see that their schedules are well balanced.

It seems to me, therefore, rather than to specialize too deeply in one branch of engineering science, it is a very good policy to take general elective courses in the other branches. After all, the world is one big family and knows no nice divisions.

ONE YEAR OUT

VIRGIL POSTON, e. '15
Chief Engineer, Electric Station, Waukesha Gas & Electric Co., Waukesha, Wis.

CONFIDENCE IN ONE'S SELF

My year and a half of experience with the Waukesha Gas & Electric Company has taught me much that I consider valuable, especially to the operating engineer. I first learned that self-confidence is absolutely necessary for any successful endeavor. When meeting the numerous difficulties that arise in the operation of any central station, without self-confidence one will soon become very discouraged and doubtless will fail to show any satisfactory results. Another thing that I have learned is that results are not accomplished over-night; and because of that, one must learn to be patient and keep continually after that which he hopes to accomplish.

The past year has been very trying to all central station operators. Enormous increases in wages in other industries, scarcity of labor, coal shortage, delayed shipments of materials, and increase in station load, all have made it difficult to maintain continuous and efficient operation. However, the central station industry offers an excellent opportunity to the young engineer to obtain a wide range of experience and the small central station has as much, if not more, to offer in this line than the larger.

The best advice that I can offer to an undergraduate who is contemplating entering central station work is to secure summer employment with some operating company and learn everything possible pertaining to central stations before choosing his position after graduation.

JUST OUT

J. E. WISE, e. '16
Student Engineer, Westinghouse Electric & Manufacturing Co., Pittsburg, Pa.

THE STUDENT COURSE

"Just Out" is an appropriate heading for the letters from the 1916 men. We are indeed out and I, for one, have sometimes wished that I were still in. Six months of experience are hardly long enough to qualify me to give "advice" and I hesitate about "suggestions," so I shall compromise on a few observations.

The student course that I am taking is arranged to give men fresh from college a chance to get some practical experience while they are finding themselves. Each man is sent into the shop, to the test floor, and to the office, in order to find out what line of work he wishes to follow. In all of these departments he is expected to work as well as learn and thus he gets accustomed to regular discipline, which is so necessary in work of this kind. In most schools the "cut rule" allowing a specified number of unexcused absences for the year is in force, and as a result some graduates have the idea that they should be allowed the same privileges while working. In such a course as this a man is taught, in part at least, the value of punctuality and regularity, for the size of his pay check is seriously affected by absence or tardiness.

So far I have not spent much time in the testing department but have had some very interesting work in the assembly of large machines for test. In the course of my work I am constantly encountering some machine or some method that illustrates principles or laws that Jimmy, Bob, and the rest, tried to teach me and I find that those same principles are not gone but are merely covered up. One bit of advice that I have to offer to the fellows who will finish soon: if you take a student course, do not expect to get a lot for nothing, for you will have to work as you never worked before.

Volume 21 Founded 1890 Number 6

The Wisconsin Engineer

$1.00 a Year 15c a Copy

Published monthly from October to May, inclusive, by
THE WISCONSIN ENGINEERING JOURNAL ASSOCIATION
306a Engineering Building, Madison, Wisconsin
Telephone University 276

Publisher's Announcement: Address all communications to The Wisconsin Engineer, Engineering Building, Madison, Wis. Subscription Prices: $1.00 a year, if paid before February 1, and $1.25 a year after that date. Canadian subscription, $1.25. Foreign subscription, $1.50. All articles printed herein may be reprinted but due credit must be given. Entered as second class matter at the postoffice at Madison, Wis., under the act of March 3, 1897.

BEING CONGENIAL

Has it ever occurred to you what being congenial means? Have you ever stopped to consider what little satisfaction you can acquire by being sharp in your answers to well-meant queries of others. Short, sharp answers, whether they be exchanged between instructor and student, or between students, create a bad feeling. When such a feeling exists between instructor and student, the instructor can not teach the subject he is treating to the best of his ability, nor can the student get the most out of the course. A little congeniality, practiced by both instructor and student, would serve to eliminate the friction which exists. Congeniality, acquired at school, will stand us in good stead when we are vested with a little authority and enable us to keep on good terms with those about us when we are "on the job."

* * *

FOREIGN LANGUAGE

A question of growing importance to the students of engineering is that of foreign language. Should two years of a foreign language be required of an engineering student before he be granted his degree? Some are of the opinion that two years of a foreign language should not be required for graduation. Others, admitting the value of foreign language, advocate that classes for engineers be formed, where a better feeling can be developed among the students in the class. A smaller group suggests the substitution of English for foreign language, so as to improve the use of English.

But wherein does lie the real value of a study of foreign language? The theory that foreign language is necessary for the study of a technical literature is hardly untenable. Has it a direct practical value? This can hardly be possible, for in most instances a good speaking knowledge can not be acquired in the short time in which the study is taken. Has such a study a cultural value? What can one obtain in the way of culture in such a brief study of the language?

But this does not necessarily condemn the study of foreign language for the engineering student, for the real benefit to be derived from such a study is the excellent opportunity afforded to learn our own language.

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ROCKETS

Once more we hear the old familiar skyrocket, dedicated to the man who is late to class, to the instructor marching up the hill with an armful of bluebooks, to the loud scarf, to the flashy skirt; all these fall in the same category for they all draw the same lusty-lunged skyrocket. Between classes everything appeals to us as requiring a skyrocket. The most ordinary exhibition of fussing seems to strike us as worthy of a display of fireworks. We greet the "low-brow" lawyers with a skyrocket, as a few of their bolder natures venture out to get a breath of fresh air, or to hear our songs. A combination of blue hat, red coat, gray-uppered shoes, and girl, invariably draws a "rocket" from the crowd on our steps We never stop to think that perhaps our fun is at some one else's expense We are plainly thoughtless about the matter. It is all right to be funny, but we ought not overdo the thing. We should discriminate so that our attention will be better appreciated when it comes at the right time and in the right place.

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THE ENGINEER OF THE FUTURE

An editorial from "Through the Meshes," a monthly publication issued for circulation to all within the business range of The W. S. Tyler Company.

Do you know who the big public man of the future is going to be? A friend, for whose observations the writer has the highest respect, threw out this question the other day. He answered it himself by stating that he looked to the engineer to handle the big political, economic, and social problems of tomorrow.

Since then I have been doing a lot of thinking along this line myself. The city-manager plan of government is spreading like wild-fire over the country. Practically all these young men who are adopting this new profession are engineers, the most prominent being Henry Waite of Dayton, who, before going to Dayton, was city engineer of Cincinnati. Secretary of United States Treasury McAdoo is an engineer, his greatest feat being the digging of the tunnels under the Hudson River. Colonel Goethals, who dug the Panama Canal, was seriously considered as a candidate for the presidency.

These examples could be multiplied indefinitely, but one of striking interest comes to our mind just now. This man is Herbert Clark Hoover, an American mining engineer, who is chairman of the Commission for Relief in Belgium. Hoover, it appears, has accomplished the impossible, forced cabinet ministers to bow to him and royalty to answer to his beck and call.

Hoover is only forty-two. He was born at Long Branch, Iowa, and was graduated from Leland Stanford University as a mining engineer in 1895. At the outbreak of the war it was said that he directed mines all over the world, and was boss of 125,000 men. His task in Belgium was to organize in a fortnight a body of volunteers for the handling of relief work on a $100,000,000 a year scale.

Throughout the world the great constructive brains have been working on engineering problems, devising labor saving machinery, annihilating space in the transmission of speech, removing obstacles in the transportation of goods, binding the city to the country by means of subways and cheap automobiles, and taking the curse out of routine work with such devices as adding machines and cash registers. The engineer is distinctly a doer. He is subject to a rigid checking up system. He is paid on the basis of accomplishment. The introduction of this type of mind into the administration of public affairs will be a distinct improvement. The engineer is in the habit of dealing with fundamental basic laws. He knows that these laws are invariable. The laws of political economy are every bit as basic and fundamental as is the law of gravitation. When we get men in charge of our affairs who will recognize this fact, we will begin to get scientific government. We look to the engineer!

THEODORE JAMES SCHROM

January 12, 1893–February 3, 1917

The many friends of Theodore James Schrom, m. '18, were shocked to learn of his death at the St. Anthony hospital of Rockford, Illinois, on the morning of February third of this year. His death came as a complete surprise to his friends who had always thought that he was one of the healthiest of athletes. Schrom was born on a farm near Rockford, and attended the parochial grade school in the city. While in high schcol he was very prominent in athletics, being especially proficient in track work. After graduation he worked a year before he entered the university. During his first year here he won his numerals in both basket ball and foot ball, besides playing on the "frosh" baseball team. The next fall saw him playing with the Varsity football team in the Lawrence and Ohio State games. Sickness kept him out for the remainder of the season but in the spring he played with the engineers' baseball team. About that time he joined the U. W. Engineers Club, in which he took an active part. Schrom played with the junior baseball squad last spring.

His sudden death brings to an end the life of one who had much before him, and the sympathy of the entire engineering college is extended to his parents in this time of their bereavement.

BERLIN ALWOOD THEODORE RUSTONE

October 24, 1888–May 21, 1916

B. A. T. Rustone, c. '09, better known to his friends and classmates as "Bat" or "Rusty" Rustone, died in a Chicago hospital May 21, 1916, several days after an operation for appendicitis. Rustone was born at Deerfield, Wisconsin, October 24, 1888. When he was two years of age his mother died and he went to live with his uncle, Mr. J. S. Prescott, of the same village. There he spent his boyhood days, working at odd jobs and attending grammar school. When thirteen years of age he entered high school, where he made a very good record. The next fall after graduating from high school he entered the university and practically paid his own way through. He was very popular with his classmates and made a very good scholastic record, graduating well toward the top of his class. The two years following his graduation saw Mr. Rustone with many engineering companies, gaining the experience which during the last five years of his life made him one of the most valuable of the designers working for the Marshall & Fox Company of Chicago.

SUCCESSFUL WISCONSIN ENGINEERS

RAY PALMER, e. '01

A man of sound judgment and of untiring energy, Mr. Ray Palmer has added vast practical experience to the advantages of the technical training acquired in this university.

Mr. Palmer was born in Sparta, Wisconsin, thirty-seven years ago, and after graduating in 1901 gained his first practical experience as assistant superintendent for J. G. White & Co., one of the largest engineering concerns in the world, in the work of installation of the street lighting system of New York City. His services were so satisfactory that the company retained him as one of their engineering staff in London where this company has large public contracts. In this service he remained several years. On his return from London, he accepted a position as electrical engineer for the Union Traction Company, a position from which he resigned in 1906 to start in engineering for himself in Milwaukee and Chicago. In 1912 Mr. Palmer was appointed by Mayor Harrison of Chicago as the City Electrician, an appointment which met with widespread approval because of the fact that it was based on merit and not on politics. This appointment surprised no one more than it did Mr. Palmer, as he had not sought the office.

Today Chicago has the most extensive and most nearly perfect municipal lighting system of any city in the world, and for this it is indebted to Mr. Palmer more than to any one man who has ever served in the capacity of City Electrician. Although he served in this position for but three years he has brought the public lighting of the city up to a standard that marked an advancement and improvement within that brief space of time greater than had been achieved in all the years that had elapsed since municipal lighting was first introduced in 1887.

Mr. Palmer commands the respect and admiration of all in the department, possessing a she does the rare qualification of being able to maintain friendly and even intimate relations with his subordinates, and yet to insist on discipline and efficiency. After his term of office, Mr. Palmer resumed his consulting engineering practice until he was offered his present position with the New York & Queens Electric Light & Power Company of Long Island City, New York, as vice president and general manager.

Mr. Palmer is a member of the City Club of New York, of the Kappa Sigma fraternity, the Western Society of Engineers, the American Institute of Electrical Engineers, the Electric Club of Chicago and the Engineers Club of New York City.

CAMPUS NOTES

Various improvements during the past few months have made the radio station at Science Hall, one of the best known and most complete stations of its kind in the country. With favorable weather conditions, nightly communication is maintained between a great number of stations within a radius of one thousand miles. At the present time the most extreme cities with which communication has been held are Tampa, Florida, and Lewiston, Montana. The Science Hall station, together with stations at Los Angeles, Denver and Albany, form the first transcontinental relay of amateur stations and would doubtlessly be taken over by the government in case of war. Professor Terry, three juniors, and three freshmen engineers are in charge of the station. The chief operator, Carl F. Kottler, is now carrying on a series of experiments on daylight and nocturnal transmission with Professor A. S. Blatterman of Washington University, St. Louis.

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Kenneth McIntosh, '20, died at the Madison General Hospital of pneumonia on the afternoon of February third. His home was in Bradford, Pennsylvania. His instructors say that he was a good student and an earnest worker. He was nineteen years old and a Triangle pledge.

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Phi Lamda Upsilon announces the election of the following men: E. B. Benger, H. H. Morris, W. Pitz, A. J. Johnson, L. J. Schwartz, W. C. Mackey, J. H. Black, N. R. Ellis, C. N. B. Hattleberg, C. F. Hayden, E. O. Kramer, J. W. Williams.

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At the regular meeting of A. S. M. E. on Thursday evening, February fifth, the following officers were elected for this semester: President, A. E. Kelty; Secretary, J. M. Wood; Treasurer, A. O. Buchholtz; Honorary Chairman, C. I. Corp.

Mr. George G. Post, a graduate of Wisconsin, and electrical engineer of the Milwaukee Electric Railway and Light Company, delivered an illustrated lecture on "Some Interesting Features of the Construction, Operation and Management of the Milwaukee Electric Railway and Light Company on Monday, February 26.

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Students and instructors who attended the two lectures given by Professor Newell of Illinois University in the Engineering Auditorium were well repaid. Professor Newell served as director of the United States reclamation service for the seven years from 1907 to 1914. He is the author of numerous books on irrigation. In his morning lecture he spoke about "The Work of the Reclamation Service" and in the evening on "Co-operation Among Engineers." In the latter he outlined the work that a local organization of engineers might accomplish. Professor Newell argues that the lawyers have their bar associations, the doctors their medical associations, and therefore why should the engineers not have some sort of a local organization to promote their interests? Such a club could give the engineering profession the publicity it needs so that the public could better appreciate the work of the local engineers. Besides this the club could take not only an active part in civic affairs but very likely be very instrumental in obtaining favorable legislation for the engineer. This subject is Professor Newell's hobby and he made his points very clearly understood.

ALUMNI NOTES

Edward Wray ch '05, E. E. '06, has recently resigned as editor of the "Railway Electrical Engineer" and has accepted the position of assistant manager of the Sangamo Electric Co., with headquarters at Springfield, Ill. Mr. H. B. Kirkland and Mr. Wray have organized the Concrete Mixing & Placing Co., manufacturing pneumatic concrete mixers, several of which are used in lining the eight miles of 13 foot water tunnel which will supply the north side of Chicago.

G. E. Booth e '16, has been made assistant to the city engineer of Fargo, N. D. His address is 6 Wyman Bldg.

S. C. Hollister m '16, is an instructor in Mechanics at the University of Illinois.

E. N. Strait e '06, E. E. '12, has resigned as chief statistician of the Wisconsin Railroad Commission to accept a position in similar capacity with H. M. Byllesby Co., public utility experts of Chicago.

F. H. Madsen min '13, is now with the Colby Mining Co., Box 708, Bessemer, Mich.

W. R. Lacey ch '15, who until recently has been a chemical engineer for the Rockford Gas Light & Coke Co. of Rockford, Ill., has resigned this position and is now working for the Coke & Gas Co., of Milwaukee.

Jacob Trantin Jr. ch '15, was a member of the First Illinois Cavalry on border duty at the Mexican front, but since being mustered out he has been seeking a position on the aeroplane corps.

W. C. Green c '16, is managing a bridge construction job at Burlington, Ia., for the Adolph Green Co. of Green Bay.

S. H. Edwards c '16, is a civil and testing engineer for the Monarch Engine Co. at Des Moines, Ia.

Irving Goldfein c '16, is instrument man for the C. M. & St. P. Ry. at Marion, Iowa, his address being 1314 5th Ave.

A. T. Newell min '15, is now employed as a research chemist. His address is, Flood Block, Anaconda, Mont.

A. R. Nottingham M. E. '10, has recently been made Assistant Professor of Mechanical Engineering at Purdue University.

A. B. Ordway c '09, has accepted the position of superintendent of the J. H. Kaian Paving Co. His business address is 312 Colby Bldg., Everett, Wash.

W. W. Petrie g '10, who for several years has been working for the Petrie Transfer and Storage Co. in Fond du Lac, Wis., assumed ownership of the company a short time ago.

G. O. Plamondon c '10, is a structural engineer for the Austin Co. of Bridgeport, Conn.

L. E. Reber Jr. c '14, has finished his graduate work at Yale and is now with the Detroit Copper Co. at Morenci, Ariz.

W. A. Roth m '12, is a mechanical engineer for the Pacific Coast Steer Co. of Seattle, Wish.

S. R. Sheldon e '94, is dean and professor of electrical engineering at the Government Institute of Technology, Shanghai, China.

Another of our engineers in China is E. C. Stocker c '09, who is assistant engineer for the Whangpoo River Conservancy of Shanghai, China.

L. A. Smith c '12 has been promoted from assistant city engineer of Madison, Wis., to superintendent of the city waterworks.

Olaf Laurgaard c '03, consulting civil engineer, of Portland, Ore., was recently elected by an overwhelming vote as a Multnomah County representative to the state legislature. Although this is his initial appearance in the political field, Mr. Laurgaard is well known throughout the Northwest due to his activities in various irrigation projects.

Announcement is made of the resignation of James G. Wray e '93, chief engineer of the central group, Bell Telephone Companies, to become associated with the firm of Hagenah & Erickson, public utility engineers, First National Bank Building, Chicago, specializing in appraisals, cost analysis and rate investigations.

C. M. Barbour m '14, has just been made electrical inspector for the Southern Pacific Co. His office is Room 1044, Flood Bldg., San Francisco, Cal.

O. G. Ward m '12, is at his home at Fond du Lac, Wis. as a result of injuries received in a street car accident in Cleveland last summer.

F. C. McIntosh c' 13, is with the promotion bureau of the Universal Portland Cement Co., 208 S. La Salle St., Chicago.

R. C. Jens m '16, is employed as a steam expert for the Illinois Steel Co., of Chicago. His address is 6450 Kimbark Ave.

We have been informed that C. M. Lewis m '16, is with the Badger Malleable & Mfg. Co., South Milwaukee, Wis.

K. R. Hare e '11, who until recently has been chief electrician of the Northern Pacific Railroad, has resigned this position and is now connected with the "Railroad Age Gazette." His office is in the Transportation Bldg., Chicago.

R. B. Kile e '15, has recently been employed by the Du Quesne Light and Power Co. of Pittsburg, Pa.

F. D. Fletcher m ' 15, is assistant engineer for the State Public Utilities Commission of Illinois. He has his office in the Odd Fellows Building, Springfield, Ill.

Friends of Loren L. Hebberd m '11, will be interested to learn of his marriage to Miss Dorothy Berry on the evening of November sixteenth at Christ Church, Savannah, Georgia. The couple will make their home in Milwaukee upon their return from the south.

F. D. Fletcher m '15, is now employed by the Illinois Public Utilities Commission as assistant engineer.

W. C. Graetz e '12, has withdrawn from the Crocker-Wheeler Co., Ampere, N. J., to become assistant superintendent of the Sefton Manufacturing Co., 1301 W. 35th St., Chicago.

E. H. Kifer e '08, who was general superintendent of the Madison Gas and Electric Co., is now general manager and secretary of the Binghamton Gas Co., Binghamton, New York.

C. H. Kypke ch '09, has been made president of the Central States Publishing Co. His business address is 623 Dwight Building, Kansas City, Mo.