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The Wisconsin Engineer

VOL. XV MARCH, 1911 No 6

THE REMOVAL OF BRASS FROM IRON.

A Practical Application of Electrochemical Passivity.

Charles F. Burgess,
Professor of Chemical Engineering.

In the December issue of The Wisconsin Engineer appeared a paper on the practical usefulness of electrolytic cathodic reduction and the use of many thousand electrolytic cells for removing tarnish from silverware. This paper on the removal of brass from iron is submitted as the continuation of a series concerning problems of practical importance upon which work has been done in the Applied Electrochemistry and Chemical Engineering laboratories of the University of Wisconsin.

All students of chemistry have had their attention called to the fact that iron may become "passive" in nitric acid solutions of certain strengths, and the students of electrochemistry have learned that the same mysterious passive condition may be imparted to iron by using it as an anode in certain electrolytes. These facts are set forth in the text books as interesting scientific phenomena, and with no suggestion of practical usefulness. Yet this property of passivity has been applied in effecting industrial savings which have aggregated several millions of dollars.

A number of years ago a problem was submitted to Prof. M. C. Beebe and the writer, in the form of a request from a bicycle manufacturer that an improved method be found for removing a thin layer of brass from bicycle frames. This was at a time when the bicycle occupied the same position in public interest as does the automobile at the present time.

One of the manufacturing operations consisted in assembling the tubes of the framework into the sockets of the head, the seat post and the hanger, and then dipping the joints into molten brass through a layer of borax flux. This resulted not only in the brass getting into the joint where it was needed, but it also distributed itself as a thin layer over the exposed parts of the frame. Enamel would not adhere properly to the brass surface, and this fact together with the unevenness produced necessitated its removal. This was done by the use of files and a large amount of labor. The objections to this process consisted in a cost of about twenty-five cents for each frame, and the damage which was frequently caused by filing too deeply into the thin steel tubes through careless workmanship. Many attempts had been made to remove this thin layer by dissolving in acids, hot cyanide solutions, and the like, but the apparently insurmountable fact came up that copper is the principal constituent of brass and that the acids would attack the steel more readily than they would the copper. These solutions therefore damaged the steel tubes long before the brass could be removed.

In taking up this problem the possibility at once suggested itself of making the frame the anode in an electrolytic cell and dissolving away the superfluous brass electrolytically, or by a reversed electroplating process. Upon trying many solutions it was found that the iron persisted in dissolving more readily than did the brass, and the problem resolved itself into finding an electrolyte which would not attack the anode iron but which would dissolve the coating metal. The fact was then recalled that iron may become passive when used as the anode in nitrate and chromate solutions. Two separate solutions were thereupon prepared and upon trial, after a few minutes' application of the electric current, the joy which was experienced by the experimenters in observing the complete removal of the surface brass exposing the smooth, bright, unattacked steel tubing was ample payment for the laborious and disheartening work which preceded it.

Measurements showed that but a small amount of electrical energy was required to do this work and that an hour's labor of a skilled mechanic could be saved for every bicycle made. The total expense for current, solution and attendant labor appeared to be less than two cents per frame as against twenty-five cents for the older method; and knowing that some of the manufacturers at that time were turning out 500 wheels per day a simple arithmetical calculation showed the possibility of effecting large savings. With such a demonstrated possibility the then youthful experimenters thought their task completed, while as a matter of fact it was but begun.

To anyone who may have the belief that the world is standing with open arms to welcome and adopt any new and useful discovery, a record of the attempts of the authors of this one to get it introduced might help to serve as a disillusionment.

Sodium nitrate, costing at wholesale about two cents per pound, was chosen as the most economical chemical to be used; electrolytic tanks suitable for handling the frames were designed, and other details of plant construction were worked out. These were submitted to various manufacturers before one was found who was willing to give it a trial. Scepticism, conservatism, the objection to interfering with factory routine were encountered, and when one manager was found willing to undertake an installation it was on the understanding that it should be operated in his plant as a secret process, and that the workmen should not be made fully acquainted with it to avoid the possibility of the competitors learning of it. To this end the white nitrate was colored with that article of domestic consumption known as blueing, and designated as "blue salts." This first installation proved to be highly successful, until after several weeks another shipment of blue salts was called for telegraphically and in urgent haste. To avoid the delay necessitated by adding the coloring matter a shipment of the natural material was made. This was followed by a complaint that it failed to work. The unused salt was thereupon sent back, blued, and returned with the result that there was entire satisfaction.

That the process was not welcomed by workmen was evidenced by a strike and several months' shut-down in another plant where the process was installed; and about this time an editorial appeared in one of the trade papers warning bicycle manufacturers to beware of fraudulent representations made by certain men claiming to be from the University of Wisconsin that they have worked out a satisfactory process for removing superfluous spelter.

Surviving this slight unpleasantness, additional efforts were made to get the process into more extended use and one of the large electroplaters' supply houses lent their assistance, and with advantageous results. But the troubles were not over. A maker of a cheap grade of wheel reported that the process would not work. Investigation showed that a malleable casting was used on the lower hanger. This particular grade of material refused to become passive but preferred to become corroded and destroyed. Another user sent an urgent call for help, saying that several hundred frames had been ruined in the tanks. Investigation showed an alarming confirmation of this assertion, and the reason was not at once evident, until it was discovered that presumably some unfriendly or ignorant employee had added common salt to the solution and thus rendered it useless. The moral drawn from this experience was that a new process must not only have intrinsic merit when properly applied but that it should be as nearly fool proof as possible.

The next experience with the limitations of the process began with the receipt of a letter which read, "The electrolytic stripping process which we installed recently worked satisfactorily for a few days, but is now damaging the frames so badly that it must be discontinued. What is the reason?" The first step of the investigator was to empty the tanks and mix up a fresh solution. This worked satisfactorily for a time, when the odor of ammonia became pronounced and the rusting of the frames commenced. The principal departure in this installation over previous ones was that the designer of the tanks had attempted an economy in the use of the sodium nitrate by tapering the sides of the tanks to correspond with the form of the bicycle frames, thus reducing the volume of the solution necessary. A study of the chemical changes taking place in the solution was then made. Hitherto attention had been given only to the anode action and the cathodic action had been overlooked. This cathodic action consisted primarily in the liberation of the sodium radical on the sheet iron cathode, and the immediate reaction of this sodium with the water, forming sodium hydrate and liberating hydrogen.

It was observed that the hydrogen was not evolved as rapidly as the amount of electric current flowing should require, the reason being that it was used in reducing the nitrate to nitrite, and the reduction proceeded even further until ammonia was formed. The sodium hydrate was just sufficient to precipitate the copper and zinc nitrates as metal hydrates, and regenerating the sodium nitrate, but the ammonia produced was in excess and caused the solution to become alkaline. Experiments showed that the presence of nitrite in the electrolyte was advantageous rather than otherwise as far as the passivity of the iron was concerned but that the excessive alkalinity of the ammonia hydrate was destructive. It was thus discovered that to make the solution continuously operative an occasional addition of nitric acid was necessary with alternation of the renewal of the entire solution from time to time. As the former appeared to be the more economical operation instructions were given that when the solution became alkaline it should be neutralized with the acid. Some time later another complaint was received, to the effect that a carboy of acid had been added to the tanks, but that brown fumes were evolved in such quantity as to quickly clear the room of workmen. Thus was evolved another detail of the instruction sheet which prescribed that the acid should be added in small quantities and at more frequent intervals, since if the solution was allowed to go too long an excessive amount of sodium nitrite is formed which in turn is decomposed by the addition of nitric acid, with the evolution of NO_2 fumes.

In this manner was developed a process which has become an important adjunct to the brazing of iron and steel parts. It finds its application not only in the manufacture of bicycles, but with automobile parts, and in various minor ways.

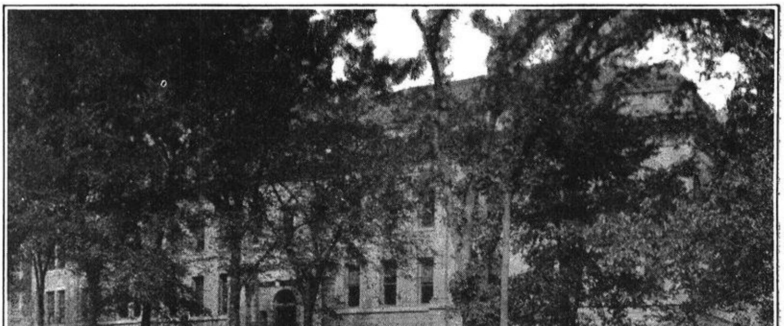
It can be employed in removing and recovering silver from worn plated ware in which iron or steel is the base.

An interesting application which is novel rather than of technical importance is the removal of brass, copper, lead or other similar metals from files which have become clogged.

Attempts have been made to remove tin from tin scrap by making the metal the anode in nitrate solutions, but while the tin is removed to a large extent, the surface of the iron still retains a coating of tin oxide which is strongly adherent.

Although copper, tin, lead, silver, brass, and zinc can be separated from iron by this process, there is one important metal at least which like iron resists the action of the nitrate radical. This metal is nickel. There is some considerable demand for a stripping method for taking nickel from iron, but it is a problem which still remains to be worked out. and some solution other than sodium nitrate must be employed if an electrolytic method is to be developed.

As far as the writer is informed, this electrolytic stripping process as an adjunct to brazing has not been fully described in technical publications, though it is known to be in extensive use. Some data on electrochemical potentials of iron in the passive condition together with other data from experimental work are given in a paper read before the American Electrochemical Society in September, 1903.



Engineering Building.

DEVELOPMENT OF THE METAL FILAMENT LAMP.

A. G. Oehler, '11.

The rapid progress in the development of the incandescent lamp during the past few years, represented by the introduction of metal filaments, has been due to a realization of the fact that the ordinary form of carbon lamp is enormously inefficient. As a matter of history, metal filaments were used before carbon filaments, but carbon filament lamps held a monopoly of the field for a period of 26 years after their invention because they were the only lamps known, rugged enough to stand prolonged service.

In order fully to appreciate the causes of the developments of the last few years in the introduction of metallic filament lamps and the relation between carbon and metal filament lamps, it is essential that we consider briefly the general theory of illumination by incandescence.

When a substance is heated to a temperature above that of the surrounding atmosphere, the energy imparted to it is given off partially by conduction and convection of heat, but for the most part by radiation of several forms of energy, namely, heat, light, electricity, actinic energy and possibly other forms, the properties of which are unknown. A slight increase of temperature above normal, will cause energy to be given off as vibrations of heat only. A further increase of temperature causes the appearance of vibrations of higher frequency and shorter wave length, finally leading, when the wave lengths become short enough, into the production of light. Some idea of the actual wave lengths of these vibrations may be had by considering the units in which they are measured. The unit wave length is termed $\mu.\ \mu.$ and is equal to one millionth of a millimeter. The eye is susceptible to only a small part of the total number of different length waves. Waves as short as 750 $\mu.\ \mu.$ given off at comparatively low temperatures, are noticeable to the eye as dark red light. Shorter wave lengths affect the eye as the consecutive colors of the spectrum, from red to violet, and wave lengths less than 400 $\mu.\ \mu.$ again become invisible to the eye, constituting the ultra violet and actinic portion of the spectrum. The vibrations given off from an incandescent body cover many octaves of wave lengths, but the wave lengths in the visible spectrum are limited to less than one octave. Therefore when we consider that all the longer waves, and some of those shorter than light waves are always given off simultaneously with the light waves visible to the eye the inefficiency of illumination by incandescence is at once apparent.

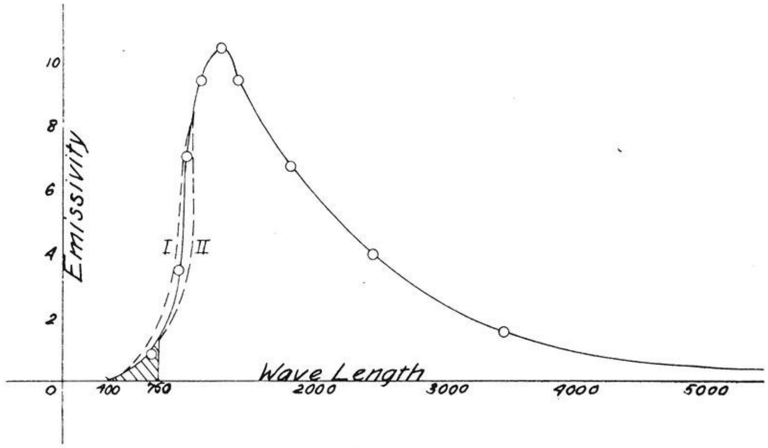


Fig. I.

This is not all. The radiant energy is not distributed evenly over the various wave lengths. By plotting quantity of energy given off as ordinates to wave lengths as abscissae, for the ordinary carbon lamp operating at a given temperature, we obtain a curve similar to that shown in Fig. I, called the emissivity curve. The ordinates of this curve represent the actual amount of energy given off at any one wave length and the area underneath the curve represents the total amount of energy emitted at a given temperature. The fact that the distribution is decidedly uneven is apparent.

Unfortunately the wave length at which the maximum emissivity occurs for carbon is about 1200 μ. μ., which value is not in the visible spectrum. The range of the visible spectrum covers wave lengths from 400 to 750 μ. μ. only; therefore the ratio of the cross hatched area to the total area under the curve represents the proportion of the total radiant energy that is available as light. In the ordinary carbon lamp this ratio is less than one hundredth and this is what is meant by the low intrinsic efficiency of carbon.

A practical method of increasing the efficiency of the incandescent substance as a light producer is to increase the working temperature. This tends to move the peak of the curve to the left. Maximum efficiency would then occur when the peak of the curve would fall over the values of wave lengths that produce visible light, as shown in Fig. II. The cross hatched area as be-

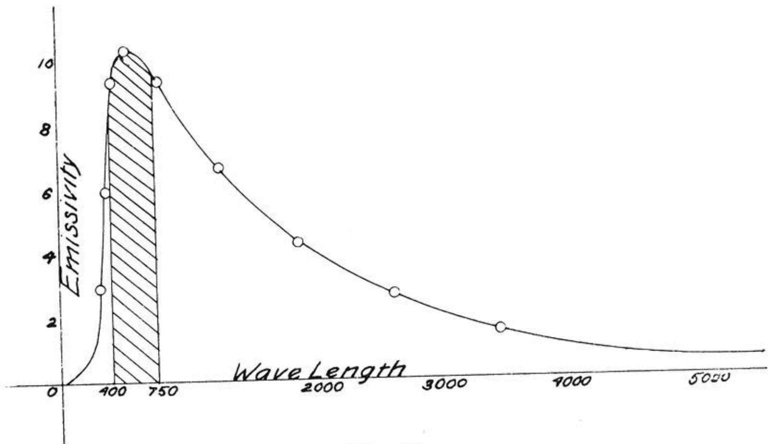


Fig. II.

fore represents that portion of the energy that is effective in the production of light. Under these conditions the efficiency of the radiant body as a light producer would be from five to ten per cent. However, the temperature necessary to produce this efficiency is far above that to which it is possible to go because of evaporation of the substance. Steinmetz estimates this temperature at 4000 to 5000 degrees centigrade. Therefore we may state that up to this limit, the greater is the working temperature of an incandescent lamp, the greater also will be its efficiency. Carbon boils at 3500 degrees centigrade. It is not, however, possible to operate a carbon lamp at a temperature above 1800 degrees centigrade on account of its high vapor tension. Carbon evaporates so rapidly at any such temperature that the life of the lamp is greatly shortened.

Another way to increase the efficiency consists in the use of a material which gives more energy in the visible spectrum than does carbon. For any temperature every material has a curve of its own. A change in the nature of the heated substance may cause a change in efficiency by changing the shape of the curve. Thus a curve such as I, Fig. I, would mean a higher and a curve such as II, Fig. I, a lower efficiency than that of carbon. This characteristic is termed selective emission.

The metals, tantalum and tungsten, have lower boiling points than has carbon, but lamps with filaments of these materials can be operated at temperatures bove 1800 degrees due to the fact that their vapor tension is lower and their density greater than that of carbon. That is they do not evaporate so rapidly as carbon at temperatures below the boiling point. Moreover it is believed that tantalum and tungsten owe some of their advantages to selective emission.

In view of what has been said with respect to conditions found in practice we may state that the following facts are of fundamental importance: The efficiency of the carbon lamp as a light producer is very low compared with the efficiency of other electrical apparatus; the efficiency of any incandescent lamp increases with the working temperature; on account of their relatively low vapor tension and favorable emissivity curves, several of the metals can be operated at a higher temperature than that to which it is possible to go with carbon and further; these metals exhibit a better efficiency than carbon at the same temperatures. Since incandescent lamps are the prime factor in electric lighting and an important source of revenue, investigators and inventors have been led to bring out the many improvements in metal filament lamps on the market today. Although metal filament lamps were first in the field of incandescent lighting they were unable to compete with carbon until the subject of lighting had been given a considerable amount of theoretical study and improvements made in the methods of manufacture.

Experiments with metal filament lamps began with the appearance of the first large unit of power. In telling of his experiments in 1810 with his battery of 2000 cells, Sir Humphrey Davy said, "And a platinum wire, one thirtieth of an inch in thickness and 18 inches long placed in circuit between bars of copper, instantly became red hot, then white hot, and the brilliancy of the light was insupportable to the eye." In the very first attempt to produce a practical incandescent lamp, experiments were made on platinum, palladium, aluminum, nickel, cobalt, iron, boron, ruthenium and chromium. The first patent on record was granted to an American, named Starr, by the English government. The lamp consisted of a simple arrangement of platinum foil between two electrodes in a Torricellian vacuum.[1] The first American lamp patent was that of S. Gardiner, Jr., and L. Blossom.[2] It was an electric signal light and consisted of a single platinum spiral operating in air. In 1879 Edison filed a patent for the carbon filament lamp and by so doing sounded the knell of all the metal filament lamps then on the market. His lamp consisted of an attenuated high resistance filament of carbon hermetically sealed in an all glass receptacle with platinum leading wires passing through the glass. The receptacle was exhausted upon a vacuum pump to a high degree prior to its being sealed hermetically. The patent was granted a few months later.[3] This lamp was marketed immediately and for 24 years it stood almost without improvement. By the use of automatic machinery for manufacturing which increased the uniformity of the filament, the initial cost was lowered and the consumption reduced from 4.4 to 3.1 watts per candle power. This was effected before 1888. From this time until 1904 improvements greatly increased the life of the lamp, but the specific consumption was not improved.

In 1904 an improvement was effected by a new process of treatment of the filament, by means of which the so called metallized carbon lamp was produced. The filament of this lamp is an ordinary carbon filament, which has been treated in an electric furnace, so that the surface is hard and smooth, has a metallic appearance and metallic properties. This lamp can be operated at a higher temperature than can the ordinary carbon lamp. It was a success and it reduced the consumption to 2.5 watts per candle power.

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1 British patent, Nov. 4, 1845.
2 U. S. patent 20706, June 29, 1858.
3 U. S. patent 223898, Jan. 27, 1880.

At about the same time a German firm produced the tantalum lamp. The filament of this lamp consisted of a very long and very fine wire drawn from metallic tantalum. This lamp reduced consumption to 2 watts per candle power. Objections, however, appeared. In order to obtain a sufficiently high resistance the filament had to be made of very fine wire. Because of this the lamps are much affected when used on 25 cycle current. During the time the wave of current passes through zero, the thread-like filament has time to cool down appreciably and a decided flicker is the result. Another result of this necessary fineness was that the lamp was fragile as compared with the carbon lamp. Moreover, the filament became very soft when the lamp was burning. This necessitated burning the lamp in a pendant position.

The tungsten lamp was produced in 1906. Although the advantages of tungsten as a lamp filament had been anticipated, it was not used previously because of its lack of ductility. Probably the best process of manufacture is the colloidal process. In this process a colloidal solution of some oxide of tungsten is forced by high pressure through a very small diamond die into the form of a fine thread. The filament thus formed is treated so that all its constituents are reduced to metallic tungsten. This lamp reduced the consumption of incandescent lighting to 1.25 watts per candle power. However, the same objections appeared against tungsten as against tantalum, including those offered by a still higher first cost.

The osmium lamp was also produced in 1906 by a process similar to that used in the manufacture of tungsten lamps and giving similar results. This lamp was in fact an imitation of the tungsten lamp. It had no advantages over the tungsten with regard to first cost or ruggedness, and as its life was a little shorter and its consumption a little higher the possibilities of the osmium lamp were soon seen to be limited.

Only one new lamp of any importance appeared on the market during 1907. This was the Helion lamp. Its filament was made by depositing silicon upon an ordinary carbon filament. It consumed 1.5 watts per candle power and the quality of the light was said to approximate very closely that of sunlight. Its greatest advantage lay in the fact that it could be manufactured in a factory equipped for making ordinary carbon filament lamps with but very slight changes. Much trouble was experienced with this lamp in finding a suitable cement for attaching the filament to the leading in wires. All of the cements produce a small amount of carbonaceous gas which is injurious to the Helion filament. For this reason the Helion lamp has never found a place on the market.

Since 1907 no new lamps of any consequence have appeared, but the developments have taken the form of improvements in the tungsten lamp. The year 1908 gave the most important of these. It was the development of the series tungsten lamp for street lighting. The one great objection to all series lamps is the danger of all the lamps in series going out or the burning out of a socket when one lamp burns out. At about the time of the appearance of the series tungsten lamp this danger was obviated by the production of the new brass film disc cut out. The action of the cut out may be explained as follows: when a lamp burns out the potential across its terminals rises instantly. When it reaches 200 volts the film of the cut out is punctured, connection is made automatically, and all the remaining lamps continue to operate as before. The production of the devise was then very fortunate for the series tungsten lamp. The new features of the series tungsten lamp as introduced to meet the demands for street lighting may be stated as follows: first, a heavier filament is used and the danger of breakage by shock almost entirely eliminated; second, due to the lower consumption of the tungsten lamp, the constant current transformers have three times the lighting capacity when operating tungsten lamps as when operating carbon lamps and over twice the lighting capacity as when gem lamps are used. In 1909 practically 90 per cent of the series incandescent lamps supplied by the lamp manufacturers were of the tungsten type.

In 1909 a talking point against multiple tungsten lamps was done away with. Experiments by George T. Hanchett showed that lamps turned at an angle are not affected by this condition. The filament softens and bends down but the expected failure or break does not occur and the life of the lamp is not impaired.

The lamp adjusts itself to these circumstances. This was then an imaginary disadvantage.

Two other important developments in the tungsten lamp during the same year were that premature blackening was done away with by improvements in manufacture and that the strength of the filaments has been greatly increased by supporting them loosely instead of rigidly as in the old type of lamps.

Further and more recent developments have been made to meet the demand for small units and the tungsten lamp is creating a revolution in the field of small lamps for battery service, for flashlights, automobile lights, etc.

This last production brings us up to date in the development of the incandescent lamp and the results of the work and experimentation in this field since the discovery of incandescence by the passage of an electric current, may be summarized about as follows:

The platinum lamp was of no consequence further than that it paved the way for the lamps that followed it.

The ordinary carbon filament lamp is a serviceable lamp with long life, but also with a very low efficiency as a light producer. It is still of considerable importance due to the fact that most of the factories in operation at present were originally equipped for its manufacture and also because of the prestige it has established in its long period of utility.

The Gem metallized filament lamp represents a considerable improvement on the old type of carbon filament lamp as it decreased the consumption of carbon filament lamps from 3.1 to 2.5 watts per candle power and increased their life by from 200 to 300 hours.

The tantalum lamp operates with 20 per cent less consumption than the Gem, but the first cost is higher and the life not so long. It may be stated that their total comparative costs as light producers are about equal.

The Osmium and Helion lamps are not a practical basis of manufacture.

The culmination of all incandescent lamp development is represented by the tungsten lamp. Its first cost is high but the lamp more than justifies its first cost in the saving of power it secures, to say nothing of its definite scrap value. The life is long, averaging in the later types of lamps about 1500 hours. The fluctuation of candle power with a gradual change in voltage is not so great as with lamps in which the filament contains carbon. On the other hand its most serious disadvantage is that the smaller lamps are much affected when used on 25 cycle current. The tungsten lamp is particularly adaptable for series lamps and small battery lamps. Special methods of packing and extra care in handling are necessary, but the breakage will undoubtedly be reduced almost to that for carbon lamps when customers learn how to use and handle the lamps.

So the tungsten lamp represents a long step in the advancement of illumination by incandescence and if in the next 50 years improvements develop in the same ratio that they have in the last 10 years, incandescent lamps will operate on a basis comparable with other electrical appliances.

AN ENGINEERING TRIP THROUGH EUROPE.

A. G. Christie,
Assistant Professor of Steam Engineering.

It is evident from the enthusiasm of our student body over the regular Junior trip, that engineering visits in general are of interest to all, especially when combined with a certain amount of sight seeing. The writer had the good fortune to spend last summer in Europe studying general engineering. He presents on the following pages some impressions of places and peoples together with notes on some of their leading engineering works. It is hoped that these may be of interest to the general reader as well as of value to the engineer.

The A. S. M. E. visit to England was described in an article in the November issue of The Engineer. The party leaving London for the continent at the conclusion of this visit on Sunday, July 31, consisted of Prof. J. W. Roe of the Machine Design Department of Yale University, Mr. George A. Orrok, Mechanical Engineer of the New York Edison Co., and the writer, accompanied as far as Belgium by Mr. F. R. Low, editor of Power and The Engineer, and Mrs. Low.

After leaving London, we travelled through picturesque Kent, which is the main fruit county of England and is also full of historic interest. We passed some large Portland cement mills as we neared Dover. Several of these were still using the old vertical kilns which seem to Americans to be very antiquated. This was a striking example of British conservatism.

As the writer was interested in cement manufacture, inquiries were afterward made in London regarding a visit to some of the principal mills. He was greatly surprised when told that there were no works in England to compare with such of our American mills as the Edison, Atlas, Helderberg or Buffington, though there were some fine mills in Germany.

The country in this section is of chalk formation, and soon the white cliffs of Dover came into view. Our whole party was routed via Ostende over the Belgian Government's mail packet line from Dover. The following Monday was Bank Holiday in England, and hence there was an enormous crowd on the train on their way to the Brussels World's Fair.

Our steamer was the Jan Bleydal. It was built in Belgium by Societe Anonyme John Cockerill, and is equipped with Parsons steam turbines. Her average speed was about 24 knots an hour. The appointments of the boat were very fine. The sea was as smooth as glass—a very unusual condition for the Channel—and the trip over the Goodwin Sands and along the Belgian coast was made without any unusual event.

Ostende, in Belgium, is one of the largest sea-bathing resorts in Europe, and the sea front with its long line of splendid hotels reminds one strongly of Atlantic City. On the beach were hundreds of those little bath wagons one sees in pictures of European seaside resorts. We did not stop off to see the town. It was decided to stop off the train at Bruges instead of going straight on to Brussels.

At Bruges we parted company with Mr. and Mrs. Low, and were soon located in our hotel.

This hotel had one interesting engineering feature. A private lighting plant was located in a small shed at the rear of a pretty back garden. This plant consisted of a 25 H. P. single cylinder gas engine operating on city gas and belted to a direct current generator which produced electricity to light the hotel and grounds and run the elevators. The regulation was very satisfactory owing to its great fly-wheel, which was three or four times as heavy as that of an American engine of the same size. At no time did we see an attendant around the plant. The engine was of German manufacture, and impressed one very strongly by its rigid and substantial construction throughout and by its positiveness of operation.

We arrived in this city early in the afternoon, and between then and twilight had ample opportunity to see the places of interest. In the thirteenth century this place was the principal commercial city of the Principality of Flanders and was a rich and thriving sea-port. Many of the streets were built along its canals. Direct communication with the sea was cut off during the Spanish occupation by the silting up of the coast harbor. Bruges, with its splendid and costly buildings and homes for that period, then settled into its dotage, and there it remains to this day, one of the quaintest and most picturesque of the towns built in Medieval times, and is certainly well worth a visit. A church festival was held the day that we were there. All the principal streets were strewn with rushes, and the houses were gaily decorated with Belgian flags and with yellow, red and black bunting—the national colors of Belgium—which added an unexpected touch of coloring to the town.

Fig. 1. Belfry of Bruges.

There is a narrow-gage street railway on some of the streets, over which a baby locomotive hauls three or four dinky old-fashioned cars. This outfit recalls the old wood-cuts representing the first steam railroads in this country.

Fig. 1 represents one of the main thoroughfares along a canal. These canals are still in use, and one sees loaded barges tied up all along the streets. Among the many interesting old buildings might be mentioned the old town hall, which is wonderfully ornamented, and the building, now a museum, that has a tower 352 feet high known as the "Belfry of Bruges," standing prominently near the center of Figure 1. This tower with its splendidly toned chimes of bells has been celebrated in one of Longfellow's poems. The small gabled windows of the old fashioned houses and the remarkable cleanness of the city's crooked, narrow streets, attract and hold one's attention at all times. Milk is delivered around town in the morning by women wearing wooden shoes. The milk itself is hauled in carts drawn by dogs. The city also has many old churches, and also some fine collections of paintings.

The prices charged for tobacco were marvelous. Havana cigars sold at from 2 to 4 cents each American money, while local cigars were even cheaper. These latter cigars were of most peculiar form. The outer end contained the bulk of the tobacco and resembled very closely the contour of the "Big Stick" so common in former cartoons of Col. Roosevelt.

From Ostende to Brussels, the country is as flat as our prairie. The land is very fertile, and is divided into such small farms that it seems hard to realize that one is not in toy-land, especially when one is used to our large western farms. Along the canals—which were frequently passed—and along the roads, there were rows of poplars from which the lower branches have been cut. Almost every one has seen these trees in reproductions of old Flemish pictures. The harvest was on at the time of our visit. Women of substantial girth and wearing wooden shoes seem to do all the work in the fields. The intensity of cultivation was wonderful. The wheat in almost every case had fallen flat. With us such wheat would have failed to fill out owing to the intense heat from our summer sun. In Belgium it seems to fill out as though standing, for the writer rubbed out a head at another place and found the grains plump and firm, though of a grade resembling our soft white winter wheat. One could also see many fine dairy cattle resembling the Ayreshires in appearance, and fine stocky Belgian draft horses.

We went to Brussels on Monday morning to see the World's Fair. Brussels is a very modernly built city, and is usually described as a beautiful city. Our impressions were not favorable to it, as the streets were littered with paper, rubbish, and dirt. In fact, it split honors with Paris as the filthiest city visited. The street car service was simply rotten. The writer has a special grudge against this city, as he had his pocket picked on one of the main streets and lost a leather bound note book containing sketches and engineering notes on a seven weeks' trip in England, all of which could not be rewritten from memory. The only money lost was one lonely American two cent stamp. Every means was tried to recover this book, but it is probable that the thief had no idea of its value and simply threw it away among the other street papers.

Our visit to the World's Fair was very short. The grounds were quite small and had a very unfinished appearance, although we were there before the fire. This fair did not compare favoably with the ones at either Buffalo or St. Louis. We failed to become interested in any of the exhibits except aeroplanes, the technical instruments and the engines in Machinery Hall. Among the latter were several large gas engines, a large number of steam turbines and one of the Humphrey gas pumps. We also noticed quite an exhibit of American machine tools. These exhibits have been described fully in technical journals and need not be discussed here.

We left Brussels in the afternoon for Liege, passing through a very pretty and picturesque section. After leaving Louvain, the country became more hilly and even rocky in places, which made frequent tunelling necessary on the railroad. Most of the small towns along the route contained foundries and other metal working establishments. The shafts of coal mines could be seen as we approached Liege. The railroad enters the valley of the Meuse at an elevation of 350 feet above Liege, and a splendid view of both the city and the valley can be obtained from this point. The grade descends at the rate of 176 feet per mile into the town.

We drove from the station at this city along some beautiful avenues to Hotel Dounen. The town is well built up, and some of its streets with their fine lawns, gardens, and rows of ornamental shade trees, are very pretty, especially those streets in the center of the town. Fig. 2 shows one of the beautiful bridges over the River Meuse. Our hotel was situated about a block from the river and on a crooked street scarcely 12 feet wide.

Liege is a city of 200,000 and is the center of an extensive coal mining district. Large gun shops, iron and steel works and engine-building plants are some of its principal factories. The city is surrounded by a circle of forts, the most important being the Citadel, which overlooks the town from the top of a steep hill.

On Tuesday morning we visited the University of Liege, intending to see the Mechanical Laboratory there. We were shown over the Mining Museum, but, as none of us spoke French, we could not make our guide understand what we wished to see, and so we missed seeing the laboratoy. Prof. Dwelshauvers-Dery has carried on fine experimental work in this laboratory.

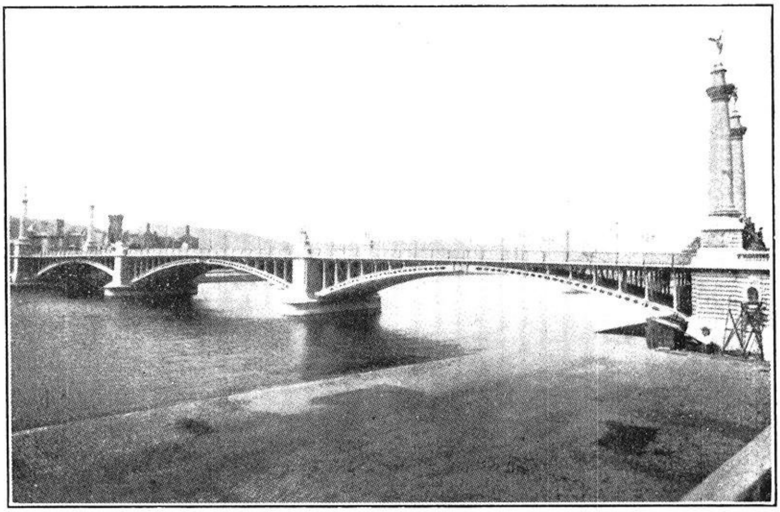

Fig. 2. One of the Artistic Bridges of Liege.

Some of his results on "The Effect of Clearance and Compression in Steam Engines" were recently published in POWER AND THE ENGINEER.

In the afternoon we went to Seraing, a city of about 40,000, situated on the River Meuse a few miles above Liege. We visited at this place the works of Société Anonyme John Cockerill, where M. Kraft, the director, received us very cordially. This property consists of about 270 acres at Seraing, besides iron and coal mines in other localities, and forms one of the largest iron manufacturing centers in Europe.

The company has six American blast furnaces. Each produces about 260 tons of iron a day with 41% iron in their ore. This is the only place the writer can recall where women were seen working in iron or steel works. They do all the hard work, such as shoveling coke, ore and slag, and loading the skips for the blast furnaces. The writer inquired why women were employed for such heavy labor and was told that they will do this class of work much cheaper than men. They receive the handsome remuneration of two francs, equivalent to 39 cents, a day, while the men are paid four francs, or 78 cents. The women appeared to be healthy, robust, and light-hearted.

The gas from the blast furnaces is purified in dry dust catchers and Theisèn washers, and is then supplied to the gas engines in the power houses. Five of these engines drive blowing tubs, while there are small single tandem units of 1000 H. P. each in another power plant, direct connected to direct current generators. All these engines were built by the John Cockerill Co., and this concern has the distinction of being the first in the world to operate gas engines with blast furnace gas, which was first done about 1895.

The slag from the blast furnaces is all manufactured into bricks and cement. We manufacture Portland Cement from slag in several places in America, but the manufacture of slag bricks has never been started, to the writer's knowledge, though it seems a profitable business in Europe.

Steel is manufactured here by the basic Bessemer process, and is rolled into various structural shapes and into railroad rails. There are also several open hearth and some puddling furnaces. A Girod electric furnace using single phase alternating current has been installed. Melted steel from the Thomas converters is poured into the electric furnace and refined, after which additions of carbon, nickel or chrome are made as required. Their forge shop is quite extensive, and contains among others a large 2,000 ton hydraulic press. Forging is quite generally done in Europe by large hydraulic presses rather than by drop hammers. Considerable armor plate of nickel steel is forged here. We saw them cutting these plates up to 8 inches in thickness with an oxy-hydrogen flame which parted the steel at a marvelous rate. Several large rings of steam turbine rotors were being forged out, while others were being roughed out in the machine shops.

These machine shops are very extensive, carefully arranged and well lighted, and contain large numbers of American machine tools. Among the important machines built here may be mentioned their gas engines, locomotives, cannon and field guns for the Belgian Government, and Parsons marine steam turbines. It is of interest to note that it was in Belgium that the Walscheart valve gear first received general application. The first locomotive on the Continent was built at the Cockerill works, and at the present time half of the locomotives of the Belgian State Railways are manufactured there.

The Cockerill gas engines have long been famous. The engine is built with a box frame and horizontal guides, such as has been adopted by the Riverside engine in this country. The cylinders are cast in one piece, and great care is taken to properly mould and gate these castings. No bushings are used and the cylinder walls seldom exceed two inches in thickness. Heavy steel bolts passing through the water jacket space, connect the front and back ends of each cylinder and take up all longitudinal strain. These bolts are kept cool by the jacket water and hence the expansion of the hot cylinders puts the metals of the walls in compression, in which condition cast iron has its greatest strength. The pistons are made in halves and bolted together. The heads of these bolts are covered by hand-hole plates, thus preventing the collection of dirt in these pockets. The engines are 4 cycle. The valves receive their motion through levers, rollers and cams from a lay shaft geared to the main shaft, as on the early Westinghouse engines. Governing is obtained by means of an eccentric motion which varies the mixture by holding down a vacuum pot during a portion of the suction stroke.

The chief offices of the Societe are in the old Chateau de Seraing. In the center of the garden of the grand court there stands a statue of John Cockerill, the founder of the works, and an Englishman by birth.

At the present time this concern employs about 11,000 persons. It also maintains a hospital, an orphan asylum, an industrial school, a school of mines, and a pension system for old employees and for those disabled at work.

We took the picturesque boat trip down the river to Liege and passed several interesting iron and steel works and other factories, as well as a large central power station.

Though one of the smallest countries in Europe, Belgium takes a foremost place among the progressive nations, as one can see from the preceding remarks. The Belgians seem to combine the thrift of the French with the progressive spirit of the Germans. In the low country of old Flanders the people are decidedly Dutch in manner, speech and dress. French characteristics predominate around Brussels, while the German influence on manners and customs is noticeable at Liege.

On Wednesday morning we left Liege for Cologne. The route passes through the very picturesque country of the foot-hills of the Ardennes, and reminds one of the Mauch Chunk country or the Lehigh Valley in Pennsylvania. The construction of a railroad in this country must have been very difficult and costly, as tunnels, sharp curves and grades are quite frequent. There were coal mines to be seen all along in Belgian territory. The small towns passed through were very pretty, and usually contained mills of some sort. This section of Belgium is noted for its splendid "country-homes" and palatial residences.

We entered German territory at Herbestall and had our baggage examined at this point.

As we approached Aix-la-Chapelle, or, as the Germans call it, Aachen, we had a splendid view of the city from the higher land to the east. There is a very good technical school here that we were sorry to miss. A fine large cathedral could be seen in the center of the town.

From here to Cologne the country was quite flat and intensely interesting as an agricultural country. The farms were larger than in Belgium, but the land was cultivated with equal intensity. The German Government takes great interest in agricultural work and country life and endeavors to render practical aid to the farming classes. Germany was the only country where the writer saw American harvesting machinery at work.

Near Cologne our attention was called to the shed of the Zeppelin Air Ship which was at that time still intact. It was a massive barn of galvanized iron, presumably supported on trussed arches similar to those used in the train sheds of our large depots. They were experimenting in an adjoining field with a new military balloon, the front end of which was cigar shaped while the rear end hung down in a huge bag. The whole thing looked unwieldy.

Cologne is probably one of the most famous and best known of the German cities. Its huge cathedral, with its spires towering to a height of 530 feet, is among the most magnificent in the whole world. The stone carving both inside and outside the church is marvelous. No description of this building will be attempted, as it has been so ably written up already.

There is now at Cologne a floating bridge over the Rhine constructed on pontoon barges, all of which are anchored except four sections in the middle. When a boat or barge wishes to pass up or down stream, these sections are uncoupled and drift rapidly down stream with the current, swinging at the same time in behind the other sections to which they are coupled. After the boat has passed, they are moved up into place again by gasoline engines and propellers installed in the pontoons themselves. It was wounderful how rapidly this bridge would open and close up again. A portion of the bridge can be seen in Fig. 3. The Rhine here is of large size, and the traffic passing up and down is enormous.

Cologne is the starting point for excursions up the Rhine, and there were many fine river steamers along the docks. There is a harbor here and the docks are splendidly equipped with a great variety of loading and unloading devices. The water level does not fluctuate to such an extent as that of the Mississippi or the Ohio, and hence it is possible to use river transportation to a greater extent than in America and also to build commodious harbors. Their barges are made of steel, and are about 100 feet long, 15 to 20 feet wide, and about 4 or 5 feet draft. They are usually loaded to 1,000 tons.

We hired a taxi and were driven about the town. The streets were built as arcs of a circle with the cathedral as a center. The most imposing of these is the beautiful Ringstrasse, built on the site of the old city fortifications. We were shown the old city walls and one of the old gates, and also many very beautiful residential streets. There is something very pleasing and comforting in driving over a German city. The streets are always well swept, the houses are neat, cheerful and homelike, the children on the streets, even in the poorest sections, are neatly dressed and clean, there is no excitement or hurry, the pavements are always in first class condition, there are no street noises, and, above all, there is no dense cloud of smoke. To realize what this means, take a run around Chicago by Clark St. or even along Michigan Boulevard.

We also drove through the old part of town past the Rathaus built on the foundation of one of the old Roman buildings of very ancient date, and the old banqueting hall belonging to the

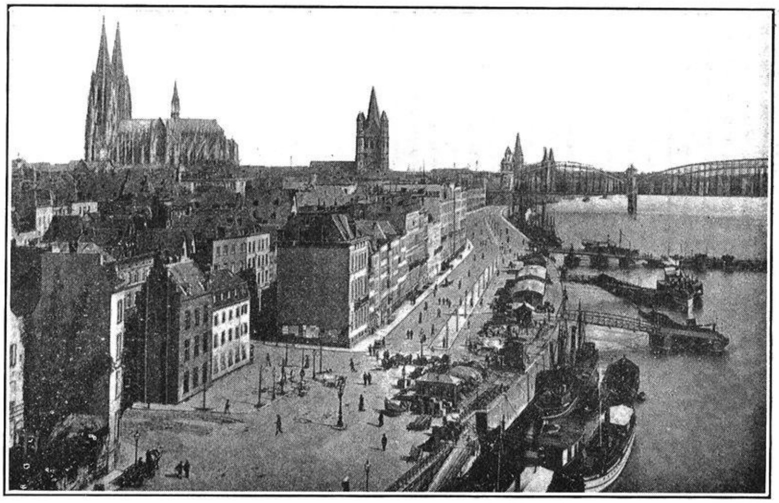

Fig. 3. Cologne and the Rhine.

city. The name of the town calls to mind Eau de Cologne, and there seemed to be an endless number of shops with this preparation for sale.

Motor taxi-cabs are very cheap in Europe, costing on an average about 40 cents a mile for the first mile and then about 13 cents for each additional mile, for two or three persons. When one does not know the city and its street car systems, it pays to use the taxi—as the saving in time and annoyance more than equals the difference in cost. As we were pressed for time, taxis were invariably used.

Across the river from Cologne the shops of Gasmotorenfabrik Deutz are located, but we had no letters to this place, much to our regret. This concern is one of the most prominent builders of small and large gas engines and producer plants. We saw many of these engines afterwards and they were of excellent construction.

Late in the afternoon we left for Düsseldorf passing across the rich flat farm lands of Westphalia, and through their busy manufacturing towns. Fine horses and cattle could be seen on these farms, while the farm houses and buildings were about the finest seen in Europe. At Düsseldorf we stopped at the Park Hotel situated in one of the best possible locations facing König's Allee, one of the finest streets, and just across the square from Hof Garten. This hotel had been strongly recommended to us as one of the finest hotels in Europe, and it equalled our expectations.

Düsseldorf is by far the finest city seen in Europe, and is also one of the greatest industrial centers. Its growth has been very rapid within the last few years. In 1885 the population was only 70,000; now it is over 350,000. With the exception of the old town, that city has been built entirely along modern lines. Düsseldorf is remarkable for the entire absence of rows of great barracks—like tenement houses seen in most large cities. Houses of the villa type with pleasant gardens predominate among the better dwellings. Flat buildings must be built only on plans approved by the city's building inspector, must provide the necessary light and air and must fully harmonize with the general scheme of city beautification, which has been definitely planned and is rigidly adhered to. In order to realize the full significance of such a system of building and beautification, one must remember that Düsseldorf is essentially a steel city.

The city owns all the public service utilities, and the service is splendid. All sections of the town are well served by street car lines. This service has one interesting feature. No overcrowding of the street cars is permitted. Only half a dozen or so people are allowed to stand, then no more are allowed to enter the cars until some one has alighted.

The city has also gone into a real estate business and buys sections of land in the suburbs, builds houses and rents these to its people in the endeavor to entirely remove the slum sections of the old town. The municipality supports the restaurant and orchestra at the Tönhalle and also owns and runs its Grand Opera house, together with some other theaters. But the principal charm lies in the beauty of its wide straight streets which are almost invariably lined with grass plots, gardens and rows of trees and which are brilliantly illuminated at night. Such streets alone are not extraordinary but when one includes splendid groups of statuary, beautiful fountains, ponds, artistic bridges and harmonious architectural effects in the surrounding buildings then one has a faint idea of Düsseldorf's beauty. One of the principal business streets of the town, König's Allee, on which our hotel was located, and part of which is shown in Fig. 5, is probably five or six times as wide as State Street, Madison. There is a driveway on both sides and some of the most imposing business houses of the city face those drives. Down the center of the street stretches the old town moat, which is spanned at each cross street by bridges of splendid design and wholly in keeping with the beauty effects desired. Some of the fountains, like the one in the picture and others farther down, add a certain sense of richness to the scene. One particular fountain attracted our attention. It is built of marble and consisted of a huge triton with a man's body, resting on a large legendary water dragon, and holding a spear at arm's length in one hand ready to strike, while the other hand clutches the nostrils of the dragon holding open its mouth, out of which pours a large stream of water. Charming small boy figures are seen peeping from behind and over the surrounding rocks to see how their father is progressing in his fight. The idea is apparent, the struggle for mastery between man and the brute.

On a parallel street, the Breite Allee, there is a similar effort at beautification, but instead of water and fountains, there are a number of fine statues. One that arrested our attention was a figure at the base of Molkte's statue. This group was in bronze and is shown in Fig. 4. It represents an old man telling a little boy, with a crude wooden sword, some stirring story of one of the glorious struggles of the Fatherland. The intense dramatic expression on the old man's face and the open-mouthed look of wonder on the boy's face are masterpieces of execution.

But the prettiest object of art of any kind that the writer saw in the whole of Europe was the Blondat-brunnen in Hof Garten just over the Golden Brücke at the end of König's Allee, and about two blocks beyond the Park Hotel. This white marble fountain is a representation of three fairy children sitting on a cloud bank with their heads together are watching three bronze frogs, with their heads also together, and each frog is pouring a stream of water at the children from the opposite side of the marble basin. The look of awe and wonder on the girl's face

Fig. 4. One of the Statues in Düsseldorf.

in the center of the group as she draws the boys to her with an arm around each, and the expression of mischievous delight and pleasure on the face of one of the boys, with a trace of fear on that of the other, are so real in the marble that one can scarcely realize that they are not actually living mortals.

In the Hof Garten facing the Rhine is a fine Art Gallery, but we did not find time to visit it. On the opposite side of the park stands one of Germany's most celebrated Schools of Art. Before leaving the subject of art, reference must be made to that triumph of artistic engineering, the new bridge over the Rhine at Düsseldorf. It contains two curved trussed spans to a central pier each 1,000 feet long. On the up-stream side of this central pier a massive tower is built, on the top of which sits the huge figure of a lion calmly looking defiance at any floods the Rhine may hurl at this structure. The approaches at either end have been designed and finished in such an artistic way as to add to rather than detract from the beauty of its surroundings.

The old part of town was very interesting with its old-world market place beside the Rhine. On one side is the new city hall, on another the remaining tower of an old castle rises, while by the river stands a portion of one of the former city gates. A block farther along is an old church whose spire has been twisted about one-twelfth of a turn.

When our cities have an area which is subject to inundation at flood time, we usually allow this land to be littered with rubbish, or to be covered with shacks and weeds at low water. The shore opposite Düsseldorf is low and subject to flood but instead of being waste land, it is put into grass as soon as the water subsides and is one of the principal play grounds of the city.

We were advised to inspect Tietz's Department Store. Now the writer has been all over Marshall Field's and the large New York stores, but this Düsseldorf store easily takes first place. It covers half a block and is of a peculiar design outside, the weight of the upper floor being carried by buttresses. The writer is under the impression that it is built entirely of reinforced concrete. It contains three inner courts all finished in marble, while the central court is most gorgeously decorated. The counters are mahogany finished, while the piers supporting the upper floors are also neatly encased in the same wood. The walls and ceilings are finished white and the lighting by reflected lights is splendid in all parts. As regards lighting, we never saw a carbon filament electric lamp after leaving England. In Germany the metallic filament lamps of high efficiency are used exclusively.

THE FIELD OF THE MANUFACTURER'S EXPERT.

GORDON FOX, '08.

Erecting Engineer, Ft. Wayne Electric Works.

The field of the larger manufacturer of electrical machinery is not confined to the mere production of isolated pieces of apparatus at the factory. He is commonly called upon to furnish complete equipments and is frequently required to go into the field and install entire plants. To safeguard his reputation he must be always ready to investigate complaints against his product and to rectify his customers' troubles. Furthermore he must be capable of advising his prospective customers how to best adapt his products to their widely varied requirements. To fulfil these functions a separate department is provided. This department is composed of two sections, an office force and a corps of experts in the field. The office force makes estimates upon furnishing and installing various groups of apparatus, provides for the producing or procuring and shipment of all material required under contracts and co-operates with the erecting men in the field.

The work of the field engineer is of three classes: the erection of machinery and installation of electrical apparatus in power plants, the investigation of complaints and rectifying of troubles and the study of the customers' problems with a view to the adaptation of electrical apparatus to his needs.

The time of the field engineer is for the most part given to the first of these duties, the installation of apparatus. Ordinarily he will superintend the unloading of the machinery from the cars and the transporting it to the power plant. Here if he is installing direct connected units he will co-operate with the engine manufacturer's expert in placing the generators and will erect the switchboard and assemble its various component parts into a complete whole. Sometimes he will have to supervise the installation of the conduit system and ordinarily will be required to install all cables and wiring in the station. All other details connected with the furnishing of a complete electrical equipment he must provide and when this work is done and all is in readiness he must place the plant in operation and adjust the apparatus for its work. Not infrequently tests are required before the machines are accepted and in such case it is the duty of the field engineer to arrange for and carry out these tests. When the electrical manufacturer contracts to furnish a complete plant including the boilers, piping, pumps and engines as well as the electrical equipment it is the duty of the electrical expert to inspect the work of the subcontractors who furnish and install the prime movers and to serve as a mediator between them and the customer.

Sometimes the manufacturer's apparatus is installed by electrical contractors and the field engineer is then often called upon to inspect the work when completed and to start the equipment into operation.

There is a feeling of achievement connected with construction work which is most satisfying and it is no little pleasure to start into operation a new plant which is, in part at least, the result of one's own efforts.

The work of "chasing trouble," as it is commonly called, leads one into a limitless variety of interesting situations. Many of the cases of complaint arise from causes inherent to electrical machinery in general such as commutator troubles. Numbers of cases are due to incorrect usage of apparatus and faulty connections or adjustments. However, often the difficulty lies along sufficiently theoretical lines to lead to quite interesting problems. Peculiar local conditions often arise requiring considerable thought to combat. A case in point might be cited.

In an Ohio city a mercury vapor rectifier outfit had been installed to regulate and rectify current for a magnetite arc system. Much trouble had been experienced due to "outage" and short tube life and the city was complaining bitterly. A thorough inspection of the apparatus and line and various tests failed to reveal anything wrong. For a week a very careful record was kept of the performance of the apparatus, noting weather conditions and every detail possibly relevant to the trouble. It was finally decided that intermittent grounds must be the root of the trouble although the lines would not reveal it nor would they break down on abnormally high voltages applied as tests. To relieve the effects of the grounds the apparatus was rearranged so that a reactance was next to each outgoing line. The reactances actually serve to choke the surging from grounds and the installation gave no further trouble.

The majority of tests which the field engineer is required to make are for the purpose of gaining information for motor applications. Often the manager of a plant will desire to install motor drive and will request the advice of the manufacturer in the matter. When requirements cannot be otherwise computed an expert is sent to investigate, make whatever tests he may find necessary, and report on condition with recommendations. Not infrequently the manufacturer of a line of machinery will desire to know the power requirements of his machines possibly with a view to the laying out of a direct driven line. In such a case the field engineer will visit the factory and will accompany a representative from the factory to a few places where the machines are in actual use, thus covering a range of conditions. He will make all necessary tests and report in detail as to the requirements and suggest methods of adaptation.

Another class of tests which are often required are made at factories having motor drive, where the power is purchased and it is desired to install an isolated plant. Here load curves are obtained, the diversity factor is studied, the groups of machines used for overtime and night work are determined, the growth of the plant is estimated, the range of working conditions is investigated and from all such information, as it is feasible to obtain, an estimate can be made of the proper installation for the particular conditions.

These, in short, are the duties of the manufacturer's expert in the field. It is a work which offers many inducements to entice the college graduate. Not only is the work itself intrinsically interesting but the opportunities which life on the road affords in meeting many classes of people in a broad range of environments, in visiting many plants and factories, and gaining an insight into numbers of diversified industries are factors which lend not a little to the development of the man as well as the engineer.

TECHNICAL JOURNALISM.

RALPH BIRCHARD, '10.
Editor, "Railway Electrical Engineer."

A FIELD FOR THE ENGINEERING GRADUATE.

It is natural that technical journalism has reached its highest development in this country. And it is natural, also, that the trend of this journalism has been toward the practical rather than toward the theoretical. The engineering journals of the United States are the most useful to the average man, and the least "technical" of any in the world.

This discussion deals with engineering journals only, though it is believed that many of the points made apply with equal force to trade journalism in other lines.

WHAT TECHNICAL JOURNALISM HAS DONE.

The improvements which have been made in engineering practice in the last fifteen years have not been due to any startling inventions, but to the working out to greater perfection of a multitude of details. Standardization of machines has done wonders in the reduction of costs. Uniform methods of accounting have made it possible for each manager to compare his work with that of others and see wherein lay his weakness and their strength.

The circulation of knowledge which has brought about this standardization and this uniformity has resulted from the work of conventions, of societies, and particularly of engineering journals.

In spreading broadcast a knowledge of what the other man is doing, the engineering journals have rendered an invaluable service not only to the engineering profession but to the public—the ultimate consumer—as well. In many cases this service has not received the appreciation it deserves. But, in general, there is a growing disposition on the part of engineers to pay attention to the technical paper, and on the part of manufacturers to take advantage of it in getting this attention for themselves. Today every engineer who deserves the name has at least one journal which he reads regularly and carefully.

Some engineering journals have built up a following as faithful as that of any old, established business house. I know one mechanical engineer who would as soon swear by the AMERICAN MACHINIST as by his Bible.

A FIELD OF USEFULNESS.

Probably every college graduate is influenced to choose his field of work chiefly by two considerations: First, its value to him. Second, its value to others.

These considerations are stated in what I think most graduates believe to be their order of importance. Undoubtedly the first thing to consider about a job is not what good it will do the world but what good it will return to the doer. The return may be simply so much money, or it may be what are commonly termed "prospects," or it may be—and I believe often is—a certain pleasant sense of satisfaction. Ordinarily it is a combination of the three.

The second consideration is most often expressed by saying that a thing is considered "worth while," which means that the person doing it feels he is performing a service to society. Engineers, as a class, are prone to consider the tangible most worth while. They prefer doing things to talking or writing about them. They would rather pack a level on an actual railroad survey than teach a class of freshmen how to adjust it. Similarly, they are likely to look down on engineering journalism as being less worth while than engineering practice.

This idea is a mistaken one. The man who tells a hundred others how to improve their methods is doing quite as much good as the man who originally plans the improvement.

Engineering journalism is distinctly worth while. And it is, on the average, quite as well rewarded as any other branch of engineering work. True, the field is not large. Ten men can put together a journal which will serve efficiently 10,000 practicing engineers. Nevertheless it is less crowded than many of the larger fields, due probably to the widely current fallacy that "us engineers ain't got no use for English, nohow."

THE WORK ITSELF.

All journalistic work is divided into editorial and business departments. This is true of engineering journalism. The relation between the two departments is closer there than in newspaper or popular magazine work. The editor must be fully informed of what the manufacturers are doing—knowledge chiefly to be gained from the advertisements. The advertising man must have a considerable familiarity with the engineering features of the things which he desires to have advertised.

The editorial work on the average engineering journal is of three distinct kinds: educational, news, and correlative.

The educational matter is scientific information, more or less technical in nature. It is usually contributed by experts. C. P. Steinmetz, for instance, may contribute an article on losses in high tension transmission, or C. F. Burgess write on some electrochemical subject. These articles give information which is new. No one else could have written them. They are extremely valuable to the few men who are able to understand and make use of the information they contain. They occupy only a comparatively small part of the space in the average engineering journal.

The reporting of news makes up the largest share of the work on most engineering journals. Of course this news is only that which pertains to the particular branch of work with which the journal deals. A civil engineering journal, for example, reports only the news of civil engineers, their methods and projects.

It frequently happens that several different journals cover the same piece of work in entirely different ways. In reporting the completion of the Kilbourn hydro-electric project, the ELECTRICAL WORLD would give chief emphasis to the electrical machinery and the transmission line; ENGINEERING NEWS would describe the dam itself, and the buildings of the power plant; CONCRETE would tell how much cement was used, and how it was used; ENGINEERING-CONTRACTING would give an analysis of the costs of construction.

News reporting for an engineering journal requires qualifications somewhat different from those for newspaper reporting. In order to intelligently report the proceedings of an engineering convention it is necessary to have considerable knowledge of the subjects under discussion. The essence of reporting is the elimination of the non-essential, and to eliminate the non-essential is just what the uninformed reporter cannot do. Fortunately the engineering journals of today are specialized to such an extent that one reporter is not expected to know the scientific principles of more than a few lines of engineering practice.

A considerable proportion of the work of each reporter, or editor, as he is called—the term reporter is not common in technical journalism—consists of abstracting reports, theses, and papers presented before the various technical societies. These reports are similar to the educational articles mentioned above, but are usually more exhaustive than it is necessary or desirable for the journal to be. Therefore each journal abstracts from them the portions of particular interest to its readers.

Aside from the reporting of conventions, expositions, and similar activities, there is a large amount of reporting to be done of the news about firms and individuals. This consists of changes of employment and location of individuals; the formation of new firms, and the combination or dissolution of old ones; and what the firms are doing, what new jobs they have undertaken, what new things they are manufacturing, etc.

Many journals report each week all new work planned or started. This is done for the benefit of subscribers interested in doing the work or in furnishing supplies for it. This information is usually secured from clipping agencies where practically all the newspapers in the country are read.

The correlative editorial work consists of showing the relation between particular events and a general situation. It supplements both the other classes. If Geo. Westinghouse contributes an article on the electrification of a certain railway, the correlative editor compares this particular electrification with others and shows its relative importance and significance.

This is usually done in what is formally known as an editorial. The idea of the editorials in most engineering journals is to show the relation between a specific instance and the general trend. That is why the writing of editorials is here spoken of as correlative editing.

THE BUSINESS END.

The work of the business department of an engineering journal consists of securing subscribers and advertising. No journal could live without advertising. No more could it secure advertising without subscribers. The more subscribers, the more advertising. The more advertising, the more money a paper can afford to spend on its editorial department.

Mere quantity of circulation is, however, a comparatively small factor. The best engineering journals in this country have a circulation less than 20,000. Yet they receive as much for their advertising space as popular magazines of ten times their circulation. The reason is that every subscriber to an engineering journal takes it to help him in his work, not to while away his idle hours. He reads the advertising pages with as much interest as the reading section, and gets from them almost as much that is of value to him.

WHAT THE WORK OFFERS.

Technical journalism offers to the engineering graduate an opportunity to earn a good living in a very pleasant way. It brings him into contact with many men and gives him a breadth of view hardly to be obtained from steady employment in the service of one of the industrial companies. It is a splendid introduction into a field; possibly the quickest way of gaining a wide acquaintance, and to the engineer in independent practice nothing is so valuable as a wide acquaintance.

The Wisconsin Engineer

EDITORIAL.

We are seldom satisfied with the value given to the work of Engineers by writers of fiction. Mrs. Humphrey Ward and Margaret Deland, for instance, scarcely disguise their scorn of the profession of an iron and steel master, and we recall strange descriptions of types of engineers by Robert Barr and Guy Thorne, who have even less understanding of their ideals and sympathy with their achievements. German and American writers, it is true, are wiser; they are better able, in their pictures of sion. True pictures of the stern work of an engineer are drawn in "Jorn Uhl" and "Hinter Pflug und Schraubstock." Jorn Uhl develops from a village ragamuffin into a useful and important Hydraulic Engineer, and the hero in Max Eyth's book, in delightful and quaint descriptions, paints true pictures of hardships and difficulties overcome in achieving a reputation among the bridge builders of England, and finishes his autobiography with a graphic account of the failure of the Tay bridge.

We are glad to welcome from a man like John Galsworthy a vivid sketch of a character and temperament which may succeed in controlling the native and human forces enrolled in constructive work, and yet finally fail from want of self-control. The forces which the hero uses are untamed, the conditions of life almost intolerable, in his work of reorganizing the operation of the New Colliery, which is apparently situated somewhere on the North American Atlantic sea board. While the man himself nervous, indomitable in overcoming nature, a king in his own creation of new civilization, fails in the end because he will not admit to himself his position of "your humble servant" to the directors. This is the motive of Galsworthy's story "The Silence" in a recent number of "The Atlantic," of which we print an epitomé.

* * *

The story is dominated by the extraordinary personality of "King" Pippin, the new superintendent who is sent out in company with Scorrier, the expert, to reorganize the moribund coal property. The first scene in London, where a self-satisfied and ignorant board instruct these two Engineers to restore the dividend-paying character of the mine, prepares us for the lonely battle which a self-reliant manager would wage with the forces of nature and man pitted against him.

Pippin and Scorrier, old schoolmates, after years of separation journey together.

"The morning of arrival at the mine was gray and cheerless; a cloud of smoke, beaten down by drizzle, clung above the forest; the wooden houses straggled dismally in the unkempt semblance of a street, against a background of woods—endless, silent woods.

An air of blank discouragement brooded over everything; cranes jutted idly over empty trucks; the long jetty oozed black slime; miners with listless faces stood in the rain; dogs fought under their very legs. On the way to the hotel they met no one busy or serene except a Chinee who was polishing a dish-cover."

"The late superintendent, a cowed man, regaled them at lunch with his forebodings; his attitude toward the situation was like the food, which was greasy, sad, and uninspiring."

Scorrier, smoking on the balcony overlooking the forest, obtained the right measure of Pippin that same evening. The nervous, capable, undaunted little man recalled to his mind the picture of a small bearded man on tiptoe, with poised head and a great sword, slashing at the castle of a giant. And now, even to Scorrier,—whose existence was one long encounter with strange places,—the unseen presence of the surrounding woods, their heavy, healthy scent, the little sounds, like squeaks from tiny toys, issuing out of the gloomy silence, seemed intolerable,—to be shunned from the mere instinct of self-preservation. He thought of the evening he had spent in the bosom of Hemmings' family, when receiving his last instructions in the security of that man's suburban villa and amid its discouraging gentility.

"Hemmings, seeing him off the premises, had said with secrecy, 'Little Pippin will have a good thing. We shall make his salary ——— pounds. He'll be a great man—quite a king. Ha-Ha!' "

"Scorrier shook the ashes from his pipe. 'Salary!" he thought, straining his ears; 'I wouldn't take the place for five thousand pounds a pear. And yet it's a fine country; ' and with ironic violence he repeated, 'a dashed fine country!' "

* * *

Eight years have passed before Scorrier again visits the new colliery.

"He would not have known the place again; there was a glitter over everything, as if some one had touched it with a wand. The tracks had given place to roads, running firm, straight, and black between the trees under brilliant sunshine; the wooden houses were all painted; out in the gleaming harbor amongst the green of islands lay three steamers, each with a fleet of busy boats; and here and there a tiny yacht floated like a sea-bird on the water."

"During the two days of his stay Scorrier never lost a sense of glamour. He had every opportunity of observing the grip Pippin had over everything. The wooden doors and walls of his bungalo kept out no sounds. He listened to interviews between his host and all kinds and conditions of men. The voices of the visitors would rise at first angry, discontended, matter-of-fact, with nasal twangs, and guttural drawls; then would come the soft patter of the superintendent's feet crossing and re-crossing the room. Then a pause, the sound of hard breathing, and quick questions—the visitor's voice again, again the patter, and Pippin's ingratiating but decisive murmurs. Presently out would come the visitor with an expression on his face which Scorrier soon began to know by heart, a kind of pleased, puzzled, helpless look, which seemed to say, 'I've been done, I know; I'll give it to myself when I'm around the corner.' "

The estimate given Pippin's work which Scorrier received from the superintendent of the adjacent mine is recorded:

" 'Why!' said the superintendent, a little man with a face somewhat like an owl's, 'd' you know the name they've given him down in the capital? "The King"—good, eh? He's made them "sit up" all along this coast. I'll tell you one thing, though—shouldn't be a bit surprised if he broke down some day; and I'll tell you another,' he added darkly,—'he's sailing very near the wind, with those large contracts that he makes. I wouldn't care to take his risks. Just let them have a strike, or something that shuts them down for a spell—and mark my words, sir—it'll be all up with them. But,' he concluded confidentially, 'I wish I had his hold on the men; it's a great thing in this country. Not like home, where you can go around a corner and get another gang. You have to make the best you can out of the lot you have; you won't get another man for love or money without you ship him a few hundred miles.' "

* * *

The crisis comes. A fearful explosion destroys life at the colliery and Scorrier hastens to the aid of Pippin. He finds him covered with dirt, helping the rescuing parties bring up all bodies, dead and alive, insisting on keeping the mine running, on recommencing cutting and hauling coal. The inevitable strike follows, then the telegram from the "Board" in London—"At all costs keep working—fatal to stop—manage this somehow." Pippin calls the surly, discouraged men together. He talks to them long and earnestly—at first apparently in vain, but finally wins them over and comes late at night to inform Scorrier.

"'The men go down tomorrow,' he said. 'What did I tell you? Carry me home on my shield, eh?'"

* * *

Prosperity reigns once more. Pippin, indefatigable, competent, dominates the environment with his personality,—supreme, he dispenses technical instructions, enforces order, grants hearing and justice to all. The dividends increase. Yet the London board is not satisfied. Pippin does not report in detail; will not write satisfactory letters. Scorrier is sent out again in company with Hemmings to inspect and insist on regular reports.

"A month passed, and Scorrier still remained Pippin's guest. As each mail-day approached, he experienced a queer suppressed excitement. On one of these occasions Pippin had withdrawn to his room; and when Scorrier went to fetch him to dinner he found him with his head leaning on his hands, amid a perfect litter of torn paper. He looked up at Scorrier."

"'I can't do it,' he said, 'I feel such a hypocrite; I can't put myself into leading-strings again. Why should I ask these people, when I've settled everything already? If it were a vital matter they wouldn't want to hear—they'd simply wire, "Manage this somehow!"'"

* * *

"But at last Pippin conquered his aversion and settled down one evening to write an orthodox letter to the board. Scorrier left him to walk through the town. Brilliantly lighted, it had a thriving air, difficult to believe of the place he remembered ten years back. The sounds of drinking, gambling, laughter, and dancing floated to his ears. 'Quite a city!' he thought. With this queer elation on him he walked slowly back along the street, forgetting that he was simply an oldish mining expert, with a look of shabbiness, such as clings to men who are always traveling, as if their 'nap' were forever being rubbed off. And he thought of Pippin, creator of this glory."

"He had passed the boundaries of the town, and had entered the forest. A feeling of discouragement instantly beset him.

The scents and silence, after the festive cries and odors of the town, were indefinably oppressive. Notwithstanding, he walked a long time, saying to himself that he would give the letter every chance. At last, when he thought that Pippin must have finished, he went back to the house."

"Pippin *had* finished. His forehead rested on the table, his arms hung at his sides; he was stone-dead! His face wore a smile, and by his side lay an empty laundanum bottle."

"The letter, closely, beautifully written, lay before him. It was a fine document, clear, masterly, detailed, nothing slurred, nothing concealed, nothing omitted; a complete review of the company's position; it ended with the words,—

'Your humble servant,
'RICHARD PIPPIN.' "

"Scorrier took possession of it. He dimly understood that with those last words a wire had snapped. The border-line had been overpassed; the point reached where that sense of proportion, which alone makes life possible, is lost. He was certain that at the moment of his death Pippin could have discussed bimetallism, or any intellectual problem, except the one problem of his own heart; *that,* for some mysterious reason, had been too much for him. His death had been the work of a moment of supreme revolt—a single instant of madness on a single subject!"

"He found on the blotting-paper, scrawled across the impress of the signature, 'Can't stand it!' "

* * *

Years pass. Scorrier—browned, shabby, rough, travelling in the Naples express, picks from his bag a newspaper clipping with the words: 'We hope that the set-back to civilization, the check to commerce and development, in this promising center of our colony may be but temporary; and that capital may again come to the rescue. Where one man was successful, others should surely not fail? For what can be sadder than to see the forest spreading its lengthening shadows, like symbols of defeat, over the untenanted dwellings of men; and, where was once the merry chatter of human voices, to pass by in the silence—'

Galsworthy thrusts no moral on us. But surely Engineers will sympathize with the temperament of Pippin. Where his responsibility was so complete, when he was proved fit to meet the demands of that responsibility, should not authority in like measure have been his? Perhaps an even greater man might have controlled himself as well as the forces of his environment. But should this extra effort have been demanded of one who had already been strained beyond reason in dominating the forces pitted against him, in the interest of his employers and of the community?

* * * *

There is one thing that every senior regrets as he looks back over his college life. It is that he did not take a greater part in student activities.

This retrospection comes with a breadth of view that was denied him as a freshman. When our senior entered the University, he quickly found that there were many, many things to do and that a College world was indeed a busy world. He was modest, untried, doubtful of his ability, and it was easy to slip along the first two or three years without endeavoring to put to some good use the hours he whiled away with conversation, cards or novels. It was as a junior or senior that he first began to see that others of no greater ability had occupied their spare time in some student enterprise and had profited thereby, not financially, perhaps, but indirectly, to a large extent.

It is not to the senior that we direct this; he has reached his zenith. It is to the freshman, who has his college world before him to live as he desires, that we say get out, join an engineering society, try out for a place on this or other magazines,—you will be welcome,—or in some way make your college life a full one,—one that will bring no regrets.

THESES SUBJECTS FOR ACADEMIC YEAR 1910–1911.

MECHANICAL ENGINEERING. (*Concl.*)

6—Investigation of the Design and Operation of the Machinery of the Launch "Cardinal" with a View to Possible Improvements to be Made.

7—Test of University Heating Plant Boilers.

8—Test of New Gas Producer and Engine Plant at Democrat Printing Office.

9—Efficiency of Pipe Covering Materials.

10—Study of Problems of Manufacture of a Gas Engine.

11—Experimental Study of Variation of Efficiency of a Gas Engine According to the Condition and Composition of the Explosive Mixture.

12—Investigation of the Specific Heat of Superheated Steam.

13—A Study of the Operations and Costs Involved in Manufacturing a Punch.

14—A Study of the Methods of Measuring Air and Gases.

15—Investigation of Tar Forming Temperatures in the Coking of American Coals.

16—A Study of the Design of Sea-going Motor Boats Suitable for Porto Rican Service.

17—The Economy of a Nordberg Compound Steam Engine as Affected by Condition of Receiver Steam.

18—The Measurement of Air and Gas.

APPLIED MECHANICS.

1—Effect of Freezing Temperature on Setting Concrete.

2—Tests on Concrete Building Blocks.

3—Tests of Bond Between Steel and Concrete Set Under Water.

4—Tests of Reinforced Concrete Columns.

NOTE.—This list of subjects is a continuation of the list published in the February issue.

DEPARTMENTAL NOTES.

CHEMICAL ENGINEERING.

During the past two years about thirty publications have been made dealing with investigation work carried on in the Chemical Engineering laboratories. There are given here a partial list of these publications, of which a number of duplicate copies are on hand. Readers of THE WISCONSIN ENGINEER may receive copies of such articles as they may choose from the list by addressing C. F. Burgess, Professor of Chemical Engineering.

Strength of Alloys of Electrolytic Iron and Monel Metal.

Strength of the Alloys of Nickel and Copper with Electrolytic Iron.

Magnetic Properties of Electrolytic Iron and Commercial Steels.

Magnetic and Electrical Properties of Iron-Silicon Alloys.

Magnetic and Electrical Properties of Iron-Copper Alloys.

Magnetic and Electrical Properties of Iron-Nickel Alloys.

Physical Properties of Iron-Copper Alloys.

Observations upon Alloys of Iron and Manganese.

Some Physical Characteristics of Iron Alloys.

Influence of Arsenic and of Tin on Magnetic Properties of Iron.

Observation of Alloys of Electrolytic Iron with Arsenic and Bismuth.

Certain Characteristics of Dry Cells.

Hardness Tests on Alloys of Nickel and Copper with Electrolytic Iron.

Corrosion of Iron.

An investigation of the comparative merits of different gas calorimeters is now in preparation. Three new instruments have been received, one being an instrument invented by Professor Parr of the University of Illinois, another one the invention of Mr. Henry L. Doherty, formerly of Madison, and a third being a Junkers calorimeter obtained from Germany, and embodying certain improvements following recommendations of reports previously made from this laboratory.

ELECTRICAL ENGINEERING.

The department of Mechanical Engineering has made rearrangements in its course whereby electrical engineering studies will be commenced in the Junior year. The Junior work will be of an introductory character and will add three credits to the number now required in electrical engineering studies. A mechanical engineer can hardly escape, if he will, being confronted with electrical problems. There is every reason for him to have a real working knowledge of electrical matters, and it is believed that the additional time to be devoted to such work is well justified and will give the opportunity for better laying the foundation for such a working knowledge.

It is significant that only recently an important official in one of the largest electrical corporations, one employing a great many college graduates, has from time to time presented various subordinates wth two dozen copies of *Wooley's Handbook of English Composition* with his compliments and a suggestion to get busy and use it.

A two-credit course in expository writing has been incorporated into the sophomore work of the electrical engineering course.

For many years there has been much complaint from business men and engineers that engineering students are woefully lacking in ability to use good English, especially in the preparation of business correspondence, specifications, instructions to departments, and in preparing advertising matter.

Much of the criticism is probably justified, but it is hardly fair to lay it all at the door of the university course. Good English, like good manners, is best acquired in the home and in the period of training preceding the university work.

However, the department feels a distinct obligations to do all it can to remedy matters as they exist, and has accordingly arranged for a two-credit course in expository writing to be given its sophomore students. The department of English will undertake the marks with the cooperation of the electrical engineering department.

It is hoped that the students concerned will also cooperate in this opportunity, so important to them, by sympathy with the object and by suggestions and courteous criticism.

WHAT THE GRADUATES ARE DOING.

This section is conducted with a double object in view—First, to give the alumni professional news of each other; second, to give the undergraduates an idea of the possible fields of employment open to them in the future.

P. S. Godfrey is with the Allis Chalmers Co.

J. C. Gapen, E. E. '03, Chief Inspector for the North Shore Electric Co. of Chicago.

O. H. Gaarden, '07, may be reached at Ewa, Oahu Island, Hawaii. He is with the U. S. C. & G. S.

Norman T. Olson is with the U. S. R. S. in Montana.

E. G. Merrick, E. E. '00, has a position as Electrical Engineer in Paris, France.

H. W. Meyer, '08, is with the Langstadt-Meyer Construction Co. of Appleton, Wis.

Paul Biefield, '94, Professor of Mathematics and Physics in Buchtel College, Akron, O.

William C. Rath, '06, is a Concrete Contractor in Milwaukee.

Geo. B. Ransom, C. E. '91, ranks as Captain in the U. S. Navy. He is also Naval Inspector of engineering material with headquarters in Boston.

H. H. Ross, '97, Ass't Engineer for the L. S. & M. S. Ry. Co., Cleveland.

J. R. Shea, '09, is with the Western Electric Co., Chicago.

R. H. Whyman, '05, is a consulting and contracting engineer with offices in Dallas, Texas.

E. R. Wiggins, Experimental Engineer with the Case Threshing Machine Co., Racine.

G. A. Wickstrom, '09, inspector for the Buffalo Ass'n of Fire Underwriters, Buffalo, N. Y.

L. E. Ward, Chemical Engineering Course, '07, is assistant to the superintendent and in charge of one of the departments of the Dow Chemical Company, Midland, Mich.

The factory of the French Battery and Carbon Co., located at Madison, of which B. B. Burling, '07, is superintendent, was recently destroyed by fire. A new building was leased and within a week's time new machinery was installed and the factory put into normal operation. This is a record for which Carl Hambuechen, '99, is entitled to credit, as he had supervision of this work.

Incorporation papers were issued on December 1 to the Northern Chemical Engineering Laboratories, located at 625 Williamson Street, Madison. These laboratories have been in operation since June, 1910, and have for their purpose the carrying on of research, experimental and development work along Chemical Engineering lines. The incorporators are Wisconsin Chemical Engineers, the officers being C. F. Burgess, James Aston, O. E. Ruhoff, and Carl Hambuechen.

R. C. Downing, Chemical Engineering, 1910, is in charge of the gas testing in Station B of the Laclede Gas Company, St. Louis, Mo.

O. W. Storey, Chemical Engineering, 1910, is located with the National Metal Molding Company, Ambridge Pa. He has charge of their work on sherardizing, the new process for coating iron with zinc, which is achieving notable success. Mr. Storey carried on investigations on sherardizing as his thesis work last year, and since then has been engaged on the commercial applications of this process for the U. S. Sherardizing Company.

L. B. Schleeder, graduate student in Chemical Engineering, during the year 1910, has recently entered the employ of the B. F. Goodrich Company, Akron, Ohio.

W. C. Andrews, Chemical Engineering, 1910, is also in the employ of the B. F. Goodrich Company. This company is one of the large rubber products manufacturers.