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THE TECHNOGRAPH

A QUARTERLY PUBLICATION OF THE ENGINEERING SOCIETIES OF THE UNIVERSITY OF ILLINOIS

VOLUME XXIX NOVEMBER, 1914 NUMBER 1

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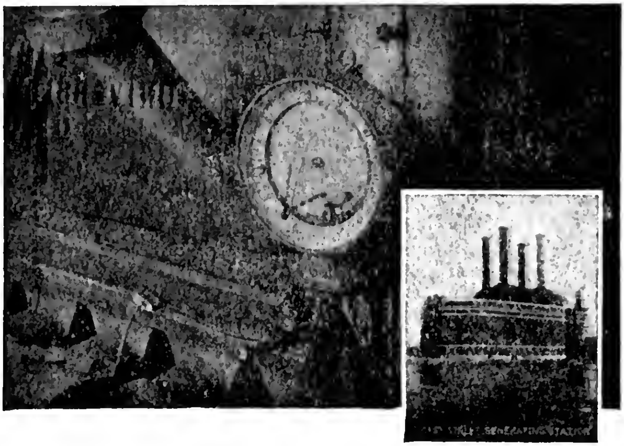

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The Technograph

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CONTENTS

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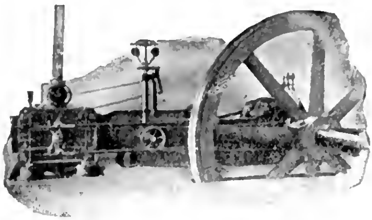

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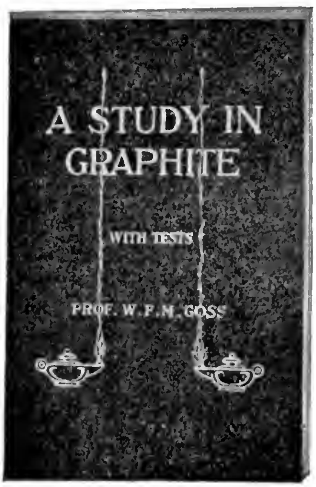

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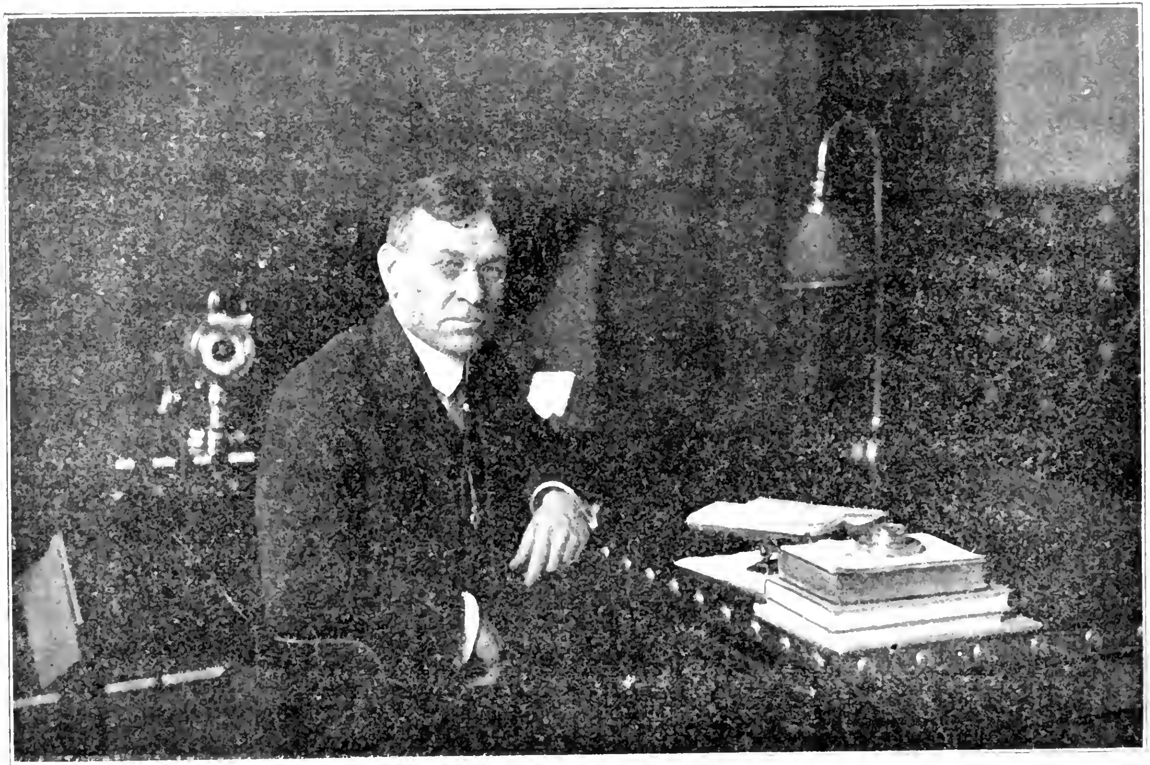


CHARLES R. RICHARDS, M.E., M.M.E.
Acting Dean Engineering College, University of Illinois

The Technograph

Vol. XXIX November, 1914 No. 1

RECENT PROGRESS IN ENGINEERING

W. F. M. GOSS, M.S., D.Eng.

Dean of the College of Engineering, University of Illinois

Probably the most important evidence of progress in engineering is to be seen in its changing methods. In the early days of engineering the desire for a result preceded the possession of an understanding of the means to be employed in securing it. Engineering was in large measure experimental. Early expectations were satisfied when proof had been given that the newly constructed bridge would stand, that the dam would hold back water, that the windmill would turn and that the locomotive would run. These were necessary first steps. Subsequently most engineering construction came to be regarded as serving two purposes, namely, that for which it was brought into existence, and that of a starting point from which designs of greater refinement might proceed. More recently the experimental character of actual structures has become a matter of diminishing importance. Engineering experimentation has not ceased, but it has been transferred from the realm of practice to the laboratory and office of the expert. The public attitude toward the engineer has changed and the engineer's conceptions of his function have broadened. The engineer is no longer a practical man only, who by sheer pluck, ingenuity and brute force accomplishes things, but is one who seeks to make all science his handmaid. This distinctly modern conception of engineering probably had its real beginning in the mathematical analyses developed in connection with bridge construction. It received a great stimulus when practice required the engineer to deal with electrical forces which are best visualized in the form of mathematical equations, and it is today finding its highest development in the synthetic work of the modern engineer who in his study of processes discovers a way to new engineering achievements.

Illustrations of the assimulation of the facts of science by engineering readily suggest themselves. The building of a canal is, in the abstract, but a question of handling earth and rock. The larger the canal, the greater the amount of materials to be handled. The construction of the Panama Canal, while a great engineering undertaking, is not different from other canals except in a single matter, namely, that the practicability of its construction centered in a problem of sanitation. On completion the Panama Canal will stand as an achievement not to the digger, but to the scientists who made it possible for the digger to do his work. Again, in the field of ceramics, the potter for generations has shaped the clay on his wheel. The process is necessarily a slow, and because of the labor involved, it is an expensive one. The modern ceramic engineer following closely the work of the chemist in the development of deflocculated mixtures, now pours liquid clay into intricate molds, which yield him at once by the expenditure of little skill a finished form perfect in detail. Again, the machine designer studying equations setting forth the laws defining the reactions between a moving blade in air, works out a design for a new type of air compressor in which a series of blades or buckets rotating between suitable guides take the place of the cylinders and pistons previously used. The result is that a lightly built compact turbo-compressor takes the place of a battery of ponderous reciprocating blowing engines, which had previously been required to maintain the supply of air for a blast furnace.

Progress in engineering, of which these illustrations are typical, has gradually made the men who are doing things men of science. It is now understood that those who are directing engineering undertakings, who are concerned with manufacturing, with building, with the operation of power plants, with public service systems, or with any engineering enterprise of whatsoever sort, must be men who are in touch with the rapidly expanding fields of scientific achievement. Business men responsible for the administration of great industrial enterprises whose chief interest is the attainment of business success are now putting a premium on college training and are guarding with jealous care the members of their staff who combine the scholarly instinct with fine qualities of character. The time is at hand when mankind will cease to classify our activities as belonging to pure science or to applied science, but will regard every way to knowledge a way to science. He who achieves through the use of the microscope or of the chemical reagent or the materials testing machine, may be a scientist or an engineer, or very likely both a scientist and an engineer.

The engineer's field of operation has in recent years been greatly extended by the introduction of new materials. Chief among these are the steel alloys. The Taylor-White high speed tool steel, in which the hardening alloys are chromium and tungsten, has revolutionized machine shop practice in rough machining forgings and castings. This steel is so hard that it requires no tempering and so enduring that it will continue at its work even when the severity of the service to which it is exposed heats it to a dull red color. To gain the full advantage to be derived from the use of this material, machine tools have been made heavier and their speed has been increased, with the result that the amount of power delivered to the point of the cutting tool has been tremendously augmented. The rate of cutting has been increased fourfold over that which was possible when carbon steel was used.

Alloy steels also in which the hardening alloys are chiefly nickel, chromium or vanadium, have found an important place in the upbuilding of engineering structures and machines. Such steels are now available, the elastic limit of which is as high as the ultimate strength of the carbon steels which until a few years ago represented the best material obtainable. The use of these alloy steels has permitted greater refinement and a reduction of weight in the design of machinery. Wherever lightness and strength are important, the new steels have entered. The development of the modern automobile has in large measure been dependent upon the availability of these hard steels, and the advent of the aeroplane waited for their coming.

Another embellishment of the modern shop equipment is to be seen in the oxyacetylene torch. This torch, while having a form which admits of its being readily handled as a tool, is in principle a bunsen burner using acetylene as fuel and oxygen instead of air. Both gases are supplied under pressure and the flame-stream is delicately attenuated. Cutting a sheet of steel an inch or more in thickness along an irregular curved line was formerly accomplished by the laborious process of boring a series of small holes, one cutting into the other, the series extending over the entire course of the desired cut. Now, where the oxyacetylene torch is available, the traveling crane drops the plate to be cut on a couple of wooden blocks to raise it a few inches above the level of the shop floor, and a workman holds for a moment the flame of a torch at the point where the cut is to start and

Note: The necessity for working these hard steels has led to the introduction of new processes in the machine shop, such, for example, as the fly-cutter instead of the milling wheel and a more general use of the grind wheels in the place of the cutting tool.

then moves it forward, following with ease and accuracy the penciled line laid down on the plate. A narrow smooth-edged kerf extending through the plate is left in the wake of the flame. Again, in repair work the end of a piston rod or of some other important part of a machine is found to have become so reduced in its dimensions that it can not be refitted. Formerly it was necessary to scrap the whole part. Now with the oxyacetylene torch and some lengths of steel wire a workman quickly overlays the worn portions of the part with a deposit of new steel securely welded to the old. The overlaid portions are afterward machine or otherwise fitted to the dimensions which they had when new. Again, since the days of George Stephenson the tubes of locomotive boilers have been fitted into the tube-sheets merely by expanding them outward to insure a close metal to metal contact between the tube-end and the tube-sheet. Tubes thus fitted often become leaky, and in many parts of the country, where the feed-water is not good, are required to have frequent attention. Repeated expansion of the tube increases the size of the hole in the tube-sheet and a gradual increase in the size of all the holes in the tube-sheet extends the external dimensions of the sheet with the result that the whole firebox construction degenerates. The renewal of fireboxes, an expensive operation in locomotive maintenance, is in many portions of our country a matter of frequent necessity. The oxyacetylene torch has entered into this field, and by its use the tube-ends of a new boiler are quickly and securely welded to the tube-sheet. The resulting joint is secure and permanent and the whole chance of subsequent difficulties is thereby avoided.

These excursions into the realm of shop practice suggest at once the achievements in modern shop management. In referring to these I am quite aware that much has been said concerning savings which are possible through the adoption of modern methods of management which probably can not be sustained, and many prophets of efficiency have arisen, some of whose doctrines are misleading and untrue, but the fact remains that the problem of industrial management is, when understood, a science, and that while it is not yet perfectly understood, much has been accomplished in working out the various terms by which its meaning is to be defined. The theory provides that under scientific management men shall be carefully selected for the work they are to perform. A man not adapted to the work of one department may be admirably calculated to succeed in another department, and the first purpose in scientific management is to find for each piece of work to be done the man best able to do it.

Those who are physically or intellectually or technically unfit are by this theory necessarily entirely eliminated. Here at the beginning, the losses and inefficiencies which under other conditions result from misfits are sought to be avoided. Next, it is the purpose to give every man employed a chance to excel in the performance of the work assigned him. He is aided in this by having set before him a definite standard of proficiency which usually takes the form of a time allowance in which to perform a given operation or task. The amount of work expected per unit of time under this arrangement is always greater than the average output under a day labor system, and in some instances it is very much greater than the amount of such output. It is never more than can be performed by a man physically adapted to the task without over exertion. The price paid labor for the accomplishment of the task is always greater than would be earned for the same hours of labor under the day-labor plan, and in general, there is an additional reward or bonus for those whose actual performance exceeds the requirements of the standard. All incidental conditions are studied with the greatest care in order that nothing may interfere or hinder the progress of the individual workman. His part is so carefully studied that every need is anticipated and every chance for delay guarded against. The movement of materials through the several stages of manufacture is controlled by a carefully scheduled program, and where the workman changes from one operation to another, the materials and the tools which are needed are ready at his hand.

The theory is that scientific management helps the workman by basing his pay upon the amount of work accomplished. If the task is a physical one, the workman possessing superior physical strength gets the benefit in his pay envelop. If the task requires dexterity in manipulation, the workman possessing skill of hand and intellectual capacity benefits. The old-time industrial soldier who only works when watched is entirely eliminated, and every man is stimulated in the performance of his task by the prospects of financial return. It is obvious that when each individual workman is striving to produce a maximum amount of work, the establishment as a whole will be operating at maximum production. With output maximum, overhead charges against the materials produced become minimum, and hence increasing the output at once operates to the advantage of the employer. The employer does not complain when his workman's earnings are large, for he knows that the greater the wage the greater also the return after the wage is paid.

Coal production in the United States continues to increase with gigantic strides. For a long series of years it has doubled with every decade, or stating the same fact in other terms, there have been produced during each ten-year period an amount of coal equal to the entire production of the country prior to the beginning of that period. In the year just ended the production is estimated to have been five hundred and fifty million tons, or in the neighborhood of six tons per capita. The proper utilization of this fuel constitutes an engineering problem of national significance. While the American people have been indifferent to their responsibility in this matter, and while the cheapness of the fuel has given rise to a condition of economic antagonism, some progress has been made. We now know how to burn Illinois coal without smoke. We do not always do it, because our convenience is served by the maintenance of conditions which are incompatible with the accomplishment of such a result. But it is true that the introduction of smokeless furnaces for industrial purposes, and especially in connection with power plants, is now general; that the gasification of coal is finding a steadily widening field of application; and that the washing and sizing of raw coals to better prepare them for domestic use is now being profitably accomplished within the borders of our own state.

In the field of steam engineering the last decade has wrought significant changes in practice. The first steam turbine operated in this country formed part of the exhibit of the Columbian Exposition here in Chicago twenty years ago. It was of 10 horse-power and consumed approximately 28 pounds of steam per horse-power hour. There have recently been installed at the Quarry Street Station of the Chicago Edison Company two steam turbines of 30,000 horse-power which consume but twelve pounds of steam per horse-power hour. The difference between 10 horse-power and 30,000 horse-power represents the growth in the size of turbines in two decades, and the difference between 28 pounds of steam per horse-power hour and 12 pounds represents the increased efficiency which has been brought about during the same period. Few who have not followed the matter in detail appreciate the number of difficult engineering problems which have appeared in bringing about this development. For example, the shaft of each of the Quarry steam turbines is a mass of highly refined steel approximately 18 inches in diameter, 30 feet in length and designed to run at 750 revolutions a minute. While this shaft is as homogeneous as modern practice can make it and while it is as prefectly fitted as practicable, it can not be depended upon to ratate upon its mechanical axis. It must be allowed to find its own axis of rotation. The difference between its axis of rotation and its mechanical axis may be hardly more than microscopic, but it is nevertheless a difference which must be recognized. Thus, the turbine buckets are carried by a series of steel discs which are mounted upon this shaft. The buckets travel with a velocity of 500 feet per second, or approximately six miles per minute. In mounting the discs, they must be forced upon the shaft at considerable pressure, since the tension of the metal of the disc in contact with the shaft is materially reduced by centrifugal action when the system is in motion. It was early found that the effect of fitting a series of these discs close together upon the shaft so increased the rigidity of the shaft itself that it was prevented from finding its axis of rotation, and that while each part was as nearly perfect as human skill could make it, the system could not be run because of lack of balance. A remedy was found when the discs were counter-bored so as to diminish the width of bearing in the shaft. By such means it has been found possible to carry the series of discs securely upon the shaft and at the same time prevent the undue stiffening of the shaft itself.

The power of this turbine is absorbed by an electric generator the rotor of which is carried by the shaft just referred to. It is an interesting fact that the output of power from this generator is limited by the efficiency of its ventilating system. Speaking in general terms, the electrical efficiency of the generator may be taken at 98 per cent. The two per cent loss in a generator developing 30,000 horse-power amounts to 600 horse-power, the heat equivalent of which must be swept away by air currents which are introduced for cooling. The provision for such currents which must be made in the complex structure of the rotor constitutes in itself an engineering problem of no small magnitude.

In 1876, 37 years ago, the first commercially successful internal combustion engine began its work. Today such engines are to be seen in every part of the world and their number is increasing at a rate which is quite beyond one's comprehension. Internal combustion engines are being operated by the use of illuminating gas, producer gas, waste gases from metallurgical furnaces, from carbureted air derived from the lighter mineral oils, and from alcohol, by the use of heavy petroleum oils and the tarry and other oil products resulting from the distillation of coals. Practically all forms of combustible liquids may be made available as fuel for the modern internal combustion engine. Such engines are being used to operate electric power stations, mill machinery, ships, railway cars, automobiles and flying machines. The farmer may buy a gasoline engine sufficient to supply power for many purposes about the farm for less than $20.00. There has never before been available to mankind a portable source of power so inexpensive and so effective.

It is the internal combustion engine which has made possible the present-day automobile and auto truck. The extent of the business which has come into being through activities in this one direction is measured by the fact that the automobile manufacturers of this country are today working upon programs which will result in the construction during the present year of nine hundred million dollars' worth of machines. The manufacturers of railway cars and locomotives are not in it with manufacturers of automobiles when it comes to volume of business. The supply of attachments and accessories for automobiles has in this country become a great business. It has been estimated by those well competent to judge that the automobiles to be built this year will require electrical attachments in the form of starters and lighting equipment which will cost automobile manufacturers not less than twenty millions of dollars. In the light of these facts it is safe to count among the engineering achievements of the past decade the complete and successful adoption of the internal combustion engine to the automobile.

The newspapers of late have had much to say concerning the Diesel engine. This is a form of internal combustion engine, the details of which are so designed as to permit it to use crude oils, or in fact almost any combustible liquid, as a fuel. The possibilities which are open to a highly efficient machine which can be operated upon oil costing a few cents a gallon as compared with one requiring fuel costing 20 or more cents, are obvious, and the promoters of the Diesel engine are meeting with great success in demonstrating its significance, especially wherever large units of power are required. There sailed into New York Harbor on September 8 last the new Hamburg-American 10,000-ton ship "Christian X". The ship to all outward appearances is a modern large-sized tramp steamer. It is, however, not a steamship, but a motor-boat, for its power is derived from Diesel engines. The efficiency of its power plant is such that it requires but 10 tons of crude petroleum per 24 hours run, and its fuel tanks permit the ship to carry 1,000 tons of fuel; that is, this ship with fuel tanks filled can keep the sea for one hundred consecutive days. It can proceed with its business quite independent of a fuel supply base, assured that when in the normal working out of its schedule it approaches a market for oil it can then refill its tanks. The design of this new ship presents a saving in weight of machinery and in weight of fuel of more than a thousand tons as compared with a steamship of the same size, and a saving in space of 30,000 cubic feet, all of which may be devoted to cargo. Its power plant staff and its fuel costs are materially reduced as compared with those of the normal steamship.

The possibility of the adaptation of the internal combustion engine to railway service as a substitute for present steam locomotives is a matter which has not escaped the promoters of the Diesel engine, and it is not impossible that in localities where the use of the steam locomotive is especially objectionable, as it is within the city limits of Chicago, a new type of engine may soon make its appearance. The engineering problems, however, which intervene between the present state of the art and such a consummation are many and difficult.

The necessary brevity in this presentation would not excuse me if I were to neglect some mention of a great engineering undertaking on the western borders of our own state. I refer to the Keokuk dam. This, as you know, is an enterprise involving the control of the entire flow of the Mississippi River and the utilization of power of an amount of water equaling the minimum flow of the river. The conception of this project, from whatever point of view it is considered, is bold and significant. Nothing approaching it in dam construction has ever before been undertaken in this country. In its dimensions and in the methods which have been employed in its construction the Keokuk dam suggests comparison with the great Assuan dam of the Nile. The project is noteworthy for reasons other than its size and cost, not the least of these being the fact that it was proposed, the detailed designes were worked out, its financial program was promoted and it is now being built by a single man, Mr. Hugh Cooper.

In the matter of electrical generation and distribution, there has been worked out here in Chicago, under the direction of Mr. Samuel Insull, the largest single public service plant which the world has thus far seen. Mr. Insull's conception has centered in a single municipal distributing system, as distinguished from a series of such systems. Development under a series of systems is to be found in the city of New York, where the elevated roads are served by a system of power plants and distributing feeders, the subways by theirs, the surface lines by theirs, the Pennsylvania Railroad by its system, and the New York Central Railroad by its system. In Chicago the entire area of the city is practically served by a single system of interconnected conductors, energized from several different stations. This arrangement permits the greatest possible flexibility in the utilization of power and the necessity for the smallest possible reserve power. In Chicago, wherever current is needed, whether for lighting, for factory power, by elevated roads or by surface cars, the system is drawn upon for the necessary supply. There is no unnecessary duplication, no great excess of investment in copper. It makes the electrical distribution for the whole city quite comparable with water distribution systems. The existence of such a comprehensive system, which has been brought into being at the expense of a tremendous amount of business pluck, of engineering skill and of administrative ability, is bound to have a decided influence upon the future development of electrical service in cities the world over.

Finally, I must note the extent to which the recent achievements of the engineer are affecting the lives and occupations of mankind. A single illustrtaion must suffice. A few years ago Illinois was known only as an agricultural state. Until 1890 as a manufacturing state it ranked below New Jersey. Today in the value of its manufactured products it is second only to New York and Pennsylvania. It continues to be a great agricultural state, but only 26 per cent of its population is now engaged in agricultural pursuits, while 49 per cent of its population is engaged in the mining, manufacturing, trade and transportation industries, that is, in those industries which have been stimulated by the activities of the engineer.

THE NITROGEN-FILLED LAMP

L. W. FAULKNER, '14

The development of an incandescent lamp of high efficiency has long been needed. The manufacturers of lamps have appreciated this need and have tried many ways to accomplish its perfection.

The first commercial carbon filament lamps had an efficiency of about five or six watts per mean horizontal candle. After many years of experimenting with the carbon filament lamps their efficiencies were increased to about 3.1 watts per candle. The introduction of the metallized filament lamp was the stepping stone to our present metal filament lamps.

In 1908 Drysdale showed that the highest efficiency that could be expected in the production of white light would be approximately .10 watt per candle, and for yellow light an efficiency as high as .060 watts per candle could be expected.

At the New York meeting of the A. I. E. E. October 10, 1913, Mr. Irving Langmuir presented the results of his experiments on the attempt to prevent the blackening of the lamp bulb used with incandescent lamps. The summary of his results as published in the A. I. E. E. Proceedings are:

1. The efficiency at which tungsten lamps may be profitably run is limited principally by the blackening of the bulb.

2. It has usually been considered, especially among those most experienced in lamp manufacture, that this was due very largely, if not entirely, to the presence of residual gases. The evidence which has led to this belief is discussed.

3. The sources of gases with the lamp are studied, and the principal gases are found to be water vapor, carbon dioxide, carbon monoxide, hydrogen, nitrogen and vapors of hydrocarbons.

4. The specific effects produced by these and other gases are determined. It is found that water vapor is the only one that produces perceptible blackening of the bulbs.

5. ——————.

6. Attempts to remove the water vapor and thus improve the life of the lamps resulted in failure. ——————

7. The real cause of the blackening in well-made lamps is proved to be due to the evaporation of the filament, which is due to its temperature alone.

8. It therefore appears that to improve the efficiency of tungsten lamps, either the rate of evaporation of the filament must be reduced or the evaporated tungsten must be prevented from blackening the lamp bulb.

9. The following methods of improving the tungsten lamp and thus increasing its efficiency are then discussed in detail:

> Introduction of gases, such as nitrogen and mercury vapor, into the bulb at atmospheric pressure.
>
> Changing the location of the deposit by means of convection currents in the gases, so that the bulb opposite the filament does not darken.

The conclusions reached in this paper point the way to the development of a lamp filled with nitrogen at atmospheric pressure.

By making use of the principles just stated Mr. Irving Langmuir and Mr. J. A. Orange started to perfect a high efficiency

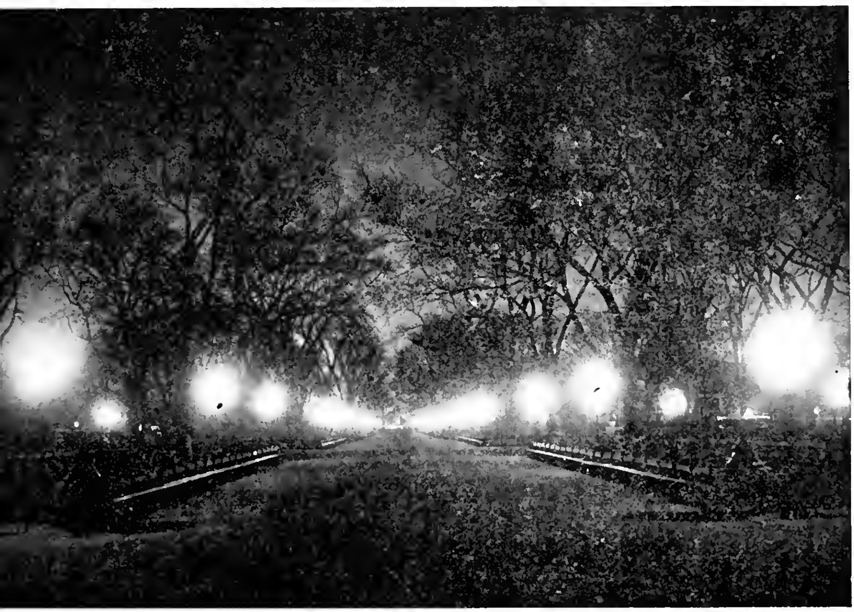
INDIRECT BOWL FOR HOUSE LIGHTING—MULTIPLE NITROGEN LAMP

lamp. In their early experiments with nitrogen-filled lamps the gas was introduced at atmospheric pressure and the ordinary straight tungsten filaments, of diameters varying from .005 to .010 inch placed in long heater bulbs, were used.

In order that the lamps thus constructed could be compared with the ordinary lamps they were set up on a life test at the same filament temperature. The nitrogen-filled lamp with a filament .005 inch in diameter had an efficiency of .65 watt per candle and a life of about 90 hours, while those of a filament diameter of .01 inch had an efficiency of .56 watt per candle and a life of about 300 hours. The part of the bulb opposite the filament remained clear, while a slight brown deposit of tungsten nitride collected in the upper part of the bulbs.

The vacuum lamps under the same conditions gave a much higher efficiency, but had a life of only 40 minutes. From these tests it was plainly shown how materially the rate of evaporation of the filament had been reduced by the presence of the gas.

Another fact that was shown by these tests was that a large filament was preferable to a small one. The large filaments not



CENTRAL PARK, NEW YORK. SERIES NITROGEN LAMPS

only gave better efficiency at a definite temperature, but also very much longer life. As the life of the filament in any lamp is determined by the loss due to evaporation, except in the case of failure due to mechanical destruction, it was of great importance to find the rate of this evaporation. This loss has been found to be dependent upon the relative decrease in diameter of the filament. If the rate of evaporation per unit area from large wires and small wires were the same, the lives of the various filaments run at a given temperature would approximately be proportional to their diameters. However, this was not found to be the case. The life of lamps with very small filaments was nearly proportional to the squares of their diameters.

Since it was found that the current taken by the filament increases nearly as the three-halves power of the diameter, to use diameters of wire as now used in the ordinary tungsten lamp it would require very large currents to supply the lamp.

Therefore, to decrease the effective diameter of the wire without decreasing its efficiency a very ingenious scheme is used. A small diameter tungsten wire is wound tightly in a helical form on as large a mandrel as good practice permits.

With a filament wound in this manner has some very interesting characteristics. Since the helix is made of fine wire it would seem that the life of the lamp would not be very long, but not so. With the filament arranged in this manner a new factor is introduced that tends to overcome the tendency of the wire to overheat in spots, due to its irregularities, which causes the filament evaporate more readily and thus decrease its life. The new factor is, when the lamp is operating at its high temperature it becomes more or less a plastic material and its weight tends to pull out the helix. This pulling out will naturally take place at the weakest point, so, when the helix is opened out there will be an increased heat loss at this point due to convection and radiation and thus prevent local overheating. On close observation of these lamps now on the market this particular point is quite evident, the portion of the helix that is stretched out has about the same brilliancy as a carbon filament lamp under normal operating conditions. In comparison to the remaining closely coiled parts of the filament this stretched part looks red instead of white. This characteristic of the helical filament to prevent local overheating increases the life of the lamp to a marked extent over the ordinary straight filament lamp.

In order to make the best possible use of this type of filament, special designed supports are required. In designing these supports they are arranged so as to give the maximum flexibility to the filament and to place it in that portion of the bulb so that the convection currents will cause the evaporated tungsten to deposit on the part of the bulb out of the light radiating zone, thus again increasing the economical life of the lamp.

As high candle power nitrogen-filled lamps require rather large currents special bases and lead-in wires are used. The bases are of the Edison type, but about two or three times larger. Platinum that was so commonly used in the old lamps is now entirely discarded, and alloys of tungsten, molybdenum or other metals that can be sealed directly into glass having the same coefficient of expansion are used in its stead.

The nitrogen-filled lamps are made in many different types for both series and parallel circuits. The present range of types may be best stated in terms of the currents and voltages required by them. The current ranges from 4 to 60 amperes and the voltage from 10 to 115 volts.

The color of the light given by this lamp is the closest to true daylight that we have been able to obtain by artificial means except, perhaps, by the light of the direct current arc or the Moore carbon dioxide tube light. Of course this light can be obtained by running the ordinary lamps at a little over double their normal voltage rating, but this is not practical.

By true daylight we mean the light given off by a black body when heated to a temperature of 5000.°C. The engineers and chemists of some of the large lamp manufactures are now working on screens to be used with the nitrogen-filled lamp so that they will be able to render the color of its light a pure daylight color. By so doing this lamp will be very useful for matching colors.

The intrinsic brilliancy of this nitrogen-filled lamp as now in use is about eight times that of the ordinary tungsten lamp. This characteristic places this lamp foremost in the field of lighting by artificial means. It is used in all kinds of projection work and for lighting large open air or enclosed areas and for street lighting. However, with these good points to its credit as a wonderful development in artificially light production, this lamp has not as yet been developed enough to be practical in small units such as required on 115 volt parallel lighting circuits used in residence lighting installations.

WORK ASSIGNMENT SCHEDULES

O. C. K. HUTCHINSON, '16

In assigning a squad of men to such work as laboratory tests, endurance runs on engines, etc., the instruction of the men is often one of the objects sought. In such cases a working schedule must be provided such that each man shall, at some time during the test, come in contact with each separate part of the work.

The methods of providing such a schedule vary widely, the most common being to divide the time allowed into a "natural"

Fig. 1.

Poriods – Time.

Jobs	1	2	3	4
1	A	B	C	D
2	D	A	B	C
3	C	D	A	B
4	B	C	D	A

Fig. 2.

Periods – Time.

Jobs	1	2	3	4	5
1	A	B	C	D	E
2	E	A	B	C	D
3	D	E	A	B	C
4	C	D	E	A	B
(5)	B	C	D	E	A

Fig. 3.

Periods – Time

Jobs	1	2	3	4	5	6	7	8	9	10
1	A	B	C	D	E	F	G	H	J	K
2	K	A	B	C	D	E	F	G	H	J
3	J	K	A	B	C	D	E	F	G	H
4	H	J	K	A	B	C	D	E	F	G
5	G	H	J	K	A	B	C	D	E	F
6	F	G	H	J	K	A	B	C	D	E
(7)	E	F	G	H	J	K	A	B	C	D
(8)	D	E	F	G	H	J	K	A	B	C
(9)	C	D	E	F	G	H	J	K	A	B
(10)	B	C	D	E	F	G	H	J	K	A

number of divisions, and at the end of each period let the men shift themselves, choosing something which they have not done before. After about four shifts, hopeless confusion results.

An improvement over this method, is for some one man to plan a schedule, and by a largely cut and try means, keep everyone moving. Various degrees of success are often obtained in this manner, but the whole scheme is lacking of systematic procedure.

Looking at the problem from the beginning, the object sought is that every man get to every job once and only once during the test. The simple way to guarantee this result, is to form a square; consider a simple case "a four hour period, a test requiring four men performing four separate parts of the test, i. e. four jobs. Let the men be "A," "B," "C," and "D," and the jobs Nos. 1, 2, 3, and 4.

Fig. 4.

Periods - Time

Jobs	1	2	3	4	5	6	7	8	9	10	
1	A	B	C	D	E	F	G	H	J	K	1
2	K	A	B	C	D	E	F	G	H	J	2
3	J	K	A	B	C	D	E	F	G	H	3
4	G H	H J	J K	K A	A B	B C	C D	D E	E F	F G	4 & (5)
5	E F	F G	G H	H J	J K	K A	A B	B C	C D	D E	(6) & (7)
6	B C D	C D E	D E F	E F G	F G H	G H J	H J K	J K A	K A B	A B C	(8), (9) & (10)

This provides the simplest possible schedule, and it is absolutely infallible.

In actual work, it is often necessary to have two men working together on one of the jobs. In such a case the question arises, shall the total time be divided into four periods (the number of separate jobs) or into five periods (the total number of men.) Investigation shows that *the total time must be divided by the number of men*, not by the number of jobs.

To lay out such a schedule, form the foundation square, as before, with five periods, five men, and four jobs. Let job number 4 be the one requiring 2 men. Combining the two bottom horizontal rows will give the desired result. Each man is assigned to each of the first three jobs once and only once, and to No. 4 job, two consecutive periods.

To try this system on a more complicated example, consider a test employing 10 men. Three jobs (1, 2, and 3) require one man each, two jobs (4 and 5) require two men each, and one job (6) requires three men.

In every case, the first thing to do is to form the foundation square between *time* and the *number of men*, without any consideration as to the number of jobs. Now for jobs Nos. 1, 2, and 3, (1 man each) take horizontal rows Nos. 1, 2 and 3. For job No. 4 (2 men) combine rows Nos. 4 and 5. and for job No. 5 (2 men), combine rows No. 6 and 7. For Job No. 6 (3 men), combine rows No. 8, 9 and 10. The resulting schedule is shown by Fig. 4.

It may be seen that each man is at jobs Nos. 1, 2, and 3 once and only once; at jobs Nos. 4 and 5, two consecutive periods, and at job No. 6, three consecutive periods. Obviously this is the best possible schedule.

In a few special cases, the feature of continuity on the "two man" and the "three man" jobs may be undesirable, the desired object being that every man change jobs at the end of every period. This may be accomplished by choosing rows which are not immediately above one another. For Job No. 4 (2 men)

Fig. 5.

Periods - Time

Jobs	1	2	3	4	5	6	7	8	9	10	
1	A	B	C	D	E	F	G	H	J	K	1
2	K	A	B	C	D	E	F	G	H	J	2
3	J	K	A	B	C	D	E	F	G	H	3
4	F H	G J	H K	J A	K B	A C	B D	C E	D F	E G	4 & (6)
5	B D	C E	D F	E G	F H	G J	H K	J A	K B	A C	(8) & (10)
6	C E G	D F H	E G J	F H K	G J A	H K B	J A C	K B D	A C E	B D F	(5),(7), & (9)

choose rows Nos. 4 and 6; (Fig. 3) for job No. 5 (2 men), rows 8 and 10; for job 6 (3 men) rows 5, 7, and 9. Check will show that no man stays on any job two consecutive periods, and that every man is on every job the proper number of times.

On jobs which have two or more men, the arrangement may be made that the man represented by the upper letter in the square shall be in charge of the squad for the period. Note that this position changes in systematic order with the change in periods.

Objection might be raised that when the total time is divided by the number of men, the periods are too short or too long. In case the resulting periods are too long, build up the program for some shorter period and repeat as much as desired, going say from period 10 to period 1, Fig.4. In case the resulting periods are too short, build the program in the prescribed manner, then drop off vertical rows until the time divided by the remaining number of rows gives the desired period length. This resulting schedule will not be perfect, but will be the best which can be arranged.

MECHANICAL ENGINEERS HOLD OPEN HOUSE

A. S. M. E. PROMOTES EXHIBITION OF WORK OF DEPARTMENT

A. F. BARRON, '15

A distinct innovation in the way of University entertainments was inaugurated on Friday evening, October 23, when the Mechanical Engineering Department held its first annual "open house". On this occasion the laboratories and shops of the department were thrown open for the inspection of the public, and during the evening about 2000 guests from all departments of the University viewed displays of student work, listened to lectures on topics of popular mechanical interest, and attended numerous demonstrations of machines in operation. The primary object of the exhibition was to acquaint the underclassmen of the department with the equipment which they will use in the more advanced work of the course, and for this reason an effort was made to utilize the regular equipment of the laboratories, under normal operating conditions, rather than to have a display of freak "stunts". A general invitation was extended to the public in order that those engaged in other lines of work might have an opportunity to see the work of the department, and to appreciate its scope.

In the mechanical laboratory, senior mechanical engineers operated steam engines, pumps, turbines, gas engines and other machines, and explained the features of their design and operation to visitors. A complete power plant of small capacity, and a ten ton refrigeration plant were in continuous operation, and demonstrations of the railway brake shoe machine were made during the evening, under the direction of Mr. A. P. Kratz. In the lecture room Prof. O. A. Leutwiler and Mr. A. B. Domonoske gave a series of illustrated talks on mechanical topics.

The exhibits in the shop laboratories consisted of displays of student work, together with feature demonstrations connected with the work of the individual shops. In the machine shop various machining operations were carried on and explained by students, and visitors were shown the details of the modern shop efficiency system which has been introduced by Prof. B. W. Benedict.

Features in the forge shop were demonstrations of oxy-acetylene and thermit welding, and in the foundry the complete process of making molds and casting pig iron was shown, the use of labor saving devices being illustrated in connection with this work. In the wood shop Mr. G. A. Gross gave a series of illustrated talks, and the process of making patterns was shown.

Novel souvenirs, consisting of hardwood inlaid "I" buttons, paperweights, and watch fobs were distributed in the shops where they were made.

The idea of the show originated with Prof. C. R. Richards, Acting Dean of the College of Engineering, and it was conducted by the student branch of the American Society of Mechanical Engineers, with the co-operation of the department faculty. It is planned to make the exhibition an annual affair, and new features will be added each year.

RAILWAYS AND THE PANAMA CANAL

A. M. TOWER, '17

There are two separate railroad systems in the canal zone, both of which will play important parts when the canal is once in use. One road, the Panama Railroad Company, is a steam road that has been in operation for some time, and the other is an electric line that will be used to tow the ships thru the canal.

The original Panama Railroad dates back to 1847, when a concession was granted to a small syndicate of Frenchmen for the construction of a railway across the Isthmus of Panama. The company, however, incurred a heavy expense in the building of the road, and failed soon after they started work. The road was then taken over by a company composed of Americans, and was called the Panama Railroad Company.

In early times, the price of a railroad ticket across the Isthmus was very high. The railway was the only way of riding from one coast to the other, and its roadbed was about the only path that the people could use to walk across. Realizing the monopoly they had on travel, the management set the price of a ticket at forty-five dollars for riding across, and at twenty dollars for using the roadbed to walk across on.

In 1906 the United States government acquired control of the road, and in 1907 began to reconstruct most of it. Since that time, about forty-two miles, nearly the entire length of the road, have had to be relocated because of the route of the canal. Climatic conditions in the canal zone are such as to make the maintenance of the roadbed very difficult, so a heavy track structure was installed to prevent serious damage to the road in the wet and dry seasons. *The Engineer*, a London publication, offers the following bit of information: "Altho the road runs thru virgin forests, most of the sleepers, or 'ties', as our American brothers call them, were brot from Columbia." The entire system is equipped with automatic block-signals, and, in fact, the whole road is quite as up-to-date as our own roads. All of the stock is new, or as good as new; originally of the best material in construction, every car, both passenger and freight, is kept in perfect condition. The locomotives are of the Baldwin type, but were erected in the Panama Railroad shops.

The Panama Railroad has been engaged in handling local and thru freight from the Pacific to the Atlantic coast ever since it was first put into operation, and the amount of business of this nature there will be after the canal is opened is still an undecided question. It appears that there will be more than enough traffic to make the road a necessity. Almost all of the supplies for the operation of the locks and for the use of the employes will come to Atlantic terminals, and will have to be transported across the canal zone. Besides, it is expected that a large body of troops will be stationed on the Isthmus, and the railway will be necessary to transfer them. Considerable passenger traffic, both local and thru tourist, is expected to continue even after the canal is opened, along with a certain amount of local freight between towns along the canal. But the traffic over which the greatest arguments have arisen is the thru freight service.

Many railway men think that the Panama Railroad will be an important factor in the transfer of freight. On the other hand, the steamship interests claim that there can be no freight transferred by rail, but that warehouses should be provided at the terminals, and an agreement entered into by the steamship interests by which all freight will be transferred by the steamship lines themselves. Col. Goethals, in his report, volunteered the opinion that "the railway being a necessary adjunct to the canal, and being unable to make a living commercially, should be operated as a part of the canal, so that the railway organization might be reduced to a minimum."

The other railroad connected with the canal is an electric line that is to be used to tow the boats thru. The track is built right along the side of the canal so the tow-lines may be fastened to the boats. There are forty electric locomotives on the system; enough to handle ten ships at once. Since no boats will be allowed to go thru the canal under its own power, four locomotives will be used on each boat that goes thru; two in front and two behind. There is a rack system between the rails on the roadbed, and a pinion from each locomotive is in mesh with it at all times, giving the locomotives complete control of the boat in their charge. The boats will be towed thru the canal at a speed of two miles an hour, and the locomotives will return at a speed of five miles an hour.

As an example of the type of station they are using, the new station at Panama offers several interesting details. The passenger traffic is divided into first and second classes, and each class has a separate waiting room. These waiting rooms, with the ticket-offices and news-stands, take up the first floor, which is about eight feet higher than the tracks. On the second floor are the offices of the cashier and the purchasing agent, and on the third floor are quarters for the employes. Outside the station are cab-stands, and a subway runs under the baggage-room, for the express and mail wagons.

ELECTRIC CONTROL OF THE PANAMA CANAL LOCKS

R. JARVIS

Mr. Schildauer, the engineer of the Panama Canal Commission, cooperating with the engineers of the General Electric Company, completely designed the control system for the immense locks of the canal system.

From the preliminary survey it was evident that the electrical system would have decided advantages over any other method of control, principally on account of the distance to which it is necessary to transmit the power for operating, and also on account of the additional refinements which this method would make possible. The switchboards for the centralized control are, as stated by the designing engineer, in fact miniature representations of the locks, chains, and gates themselves. Besides providing ready means of operating the main apparatus, they indicate every movement of all the operating parts of the locks.

At Gatun this operating machinery is distributed over nearly a mile. To control this locally would have been impracticable, and to transmit the amount of power required would have been practically impossible except by means of electricity. The operating of the "rising-stem" valves of the culverts conducting the water to the locks alone requires 40 H. P. each, for even as they are divided into pairs they measure 8 by 18 feet. All such valves are in duplicate, as a precaution against interruption in case of a single failure.

Between the locks themselves are the "mitreing-gates", so called from the manner in which they close—"on a mitre". These are in turn locked shut by a mitre-forcing machine.

In front of all these gates are stretched heavy fender-chains to protect them from accidental collision of vessels. The lowering of these chains to allow the proper passage of ships is accomplished by means of hydraulic machinery, thus illustrating a special application of the transformed electric power. A peculiar example of automatic local control is that of the hand-rails on these mitreing-gates. These would ordinarily offer an obstruction to the towing cables when the gates are opened for ship passage, so they are normally kept in the lowered position. Anyone desiring to make use of this peculiar hand-rail, however, may move it up into position by means of a specially provided foot-controller; but as these gates are again opened the hand-rails automatically disappear.

The control house is so located that the operator, who has complete charge of all locking operations, may best overlook the entire situation tho he receives his directions from the engineer of the electric towing locomotives which are used exclusively to move all boats thru these locks.

In the control house are the combined control-boards and lock-indicators. This piece of apparatus is made as nearly as possible a miniature reproduction of the actual lock equipment, the indicators showing clearly the actual position of all gates as well as the adjacent water-levels. Directly below the control board is built the complete mechanical interlocking mechanism for the entire control system. This feature would furnish a complete study in itself, but it completely fulfills its purpose of rendering impossible any error in the proper order of operations for "locking thru".

The control connections are arranged, however, so that each machine may also be controlled locally to provide for emergency operation in case of accident to the main apparatus.

Of peculiar interest also is the fact that on account of the excessively moist climate, practically all metal operating parts of the control apparatus were required to be of special material or finish in order to prevent deterioration in service; and the necessity of continuous operation in spite of being so remote from any source of electrical supplies made it imperative for all apparatus to be as nearly "fool-proof" as possible.

CIVIL ENGINEERING FEATURES OF THE PANAMA CANAL

P. W. FREARK, '16

The civil engineering features of the Panama canal are so numerous that I will mention just a few, describe the most important and point out why they are important. Harnessing the flood waters of the Chagres river which cut across the canal at several places was a difficult task; the level of the lake at Gatun had to be raised to the canal level and this was solved by the great Gatun dam; the construction of the locks and retaining walls, where necessary, to confine the water to the canal; the large modern excavating machinery, track movers, construction trains and their operation are all wonderful engineering feats.

The most prominent problems confronting the engineer were to secure sanitary camps and to cut the channel thru Culebra. Sanitary camps may not appear, on first thought, to be an engineering problem, but nevertheless they are vital when the successful completion of the whole depends on the health and comfort of the skilled laborer and engineer. The importance of sanitary quarters and wholesome food is shown by the sickness and disease prominent in the French companies' camps. Many men died from typhoid, yellow and malarial fever, while others refused to work under such conditions. The first important requisite was pure water and proper storage facilities for all the camps, and furthermore, these had to be ready when the men moved into camp. The principal menace to camp life was the mosquito, which transferred malaria and yellow fever. This pest was combatted by draining the stagnant pools and pouring petroleum on the surface of the ponds, which could not be drained, to kill the larvæ. This was done every morning to prevent the mosquito from endangering the health of this vast army of laborers. It was thru the co-operation between the department of health with the engineers that the work on the canal was completed.

Engineers conceded that the successful completion of the canal depended upon overcoming the obstacles caused by excavating the channel thru Culebra, the highest hill on the proposed canal route. When the French company controlled the project a number of large European contractors tried to excavate the cut, but their efforts failed and they gave up in despair. They said the canal could never be cut thru Culebra. They claimed that during the rainy season the soil became so sticky that it clung to the excavating buckets insted of dumping into the cars; the rails and ties would sink so deep that it was almost impossible to shift the track, and after the wet season the machinery was in such condition that considerable time elapsed before it could be put into working order. The gravity of the situation can best be shown by an example. Before the rainy season opened, a certain section was excavated with the proper side slopes and a train of cars was left standing in the cut. After the rains the side slopes were washed out from five to ten feet deep and the cars were nowhere to be seen. The greatest difficulty experienced in Culebra cut was the sliding of large masses of material into a recently excavated cut. This recalls the fact that only recently a huge mass of material slid into the canal delaying traffic for four days while the canal was being dredged.

To understand the enormity of the problem which confronted the engineers, it is necessary that we have some conception of the geological formation. In the vicinity of Gold hill, which is a part of the main cut, the lower formation consists of a mass of volcanic agglomerates, tuffs, lava flows, and dikes, with the strata running in no particular direction. The lower formation is covered with soft, thinly bedded, carbonaceous clays and shales, containing some lenses of sand and marl. When the cut was opened and this material exposed to the atmosphere, it oxidized and sufficient heat was created to ignite the surrounding material. The report circulated by the newspapers that there were active volcanoes in the canal zone was caused by this simple phenomena. This material has a low crushing strength and is very subjective to weather and erosive processes. However, the newest rocks are intrusions and dikes consisting of Isthmian basalt, which is very hard and tensile, except where jointed. The slides that occurred in Culebra cut may be classed into four groups: the deformation slide due to the uneven formation of the earth's crust, the gravity slide where loose material slides by the force of gravity, the fault zone slide caused by water making the joints of large masses of material slippery, and the weathering and erosive agents. During the formation of the earth's crust large quantities of material were pushed up, when cold, by meta tuff masses. This is gradually settling back, creating a zone of sheared rock ten to fifteen feet wide. Evidences of schared rock are discernible on Gold and Contractors hills, and Culebra Cut to a great extent. Excavation and blasting have caused these large layers of weakened material, on steep slopes, to slide into the canal. This is called a deformation slide. When these slides occur, a correspondent upheaval in the bottom of the canal near the slide occurs, showing that the rock slides down the sides in a curve, gouging the side slopes and forcing the material up in the bottom of the canal. The gravity slide originates where areas of porous material on top of impervious clay and shale beds and dense lava exist. The rain saturates the top layer causing a muddy, slippery zone between the porous material, and clay beds which will slide if the strata slopes toward the canal and there is sufficient head pressure behind to set the mass in motion. The largest of these slides was the Caracache slide in 1887, which covered fifty acres. Slides which occur at an angle with the canal open crevice in the rock perpendicular to the plane of the slide. When water seeps into these crevices the foundation material is softened causing the rock to slide into the canal. These fault zone slides are first detected by the crevices in the slope, but the material may stand for a year before it slides. Last, but not least, are the weathering and erosion agents, for these are active all the time. In Culebra cut the rock is basic, containing iron and magnesium compounds. The ferrous form of iron oxidizes to ferric upon exposure to the atmosphere, and with a consequent change in volume the rock crumbles. The heavy tropical rains wash this material away and the chemical reaction is repeated.

With such conditions prevailing you can readily see the enormity of the engineer's task. Culebra is three hundred and fifty-four feet above sea level and one hundred and twenty-five feet was excavated for the channel. If the slopes were made steep the banks would slide into the channel, and every time a slide occurred it paved the way for another, because the material beneath was loosened. It was necessary, therefore, to make the slope gradual, ranging from nearly vertical to one in five, depending upon the material, to prevent slides. But this necessitated a vast amount of excavation which could be saved if the sides were made steeper. However, the cost of this extra excavation was deemed expedient rather than risk the slides, which left the slopes broken and the material would subsequently have to be hauled out of the channel.

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EDITORIAL

Registration this year has shown more than ever the desire of the engineer to enroll in studies outside his prescribed course. The men registered in Rhetoric, Philosophy, Public Speaking, and Economics, show a great increase in those from the College of Engineering. Many of these men are carrying these subjects as extra work; others are using it where they have electives. Some, however, are passing by all hopes of a degree and taking courses which might be termed "Business Engineering". They are the men who intend to enter the business or commercial side of engineering instead of the design or construction phase. Some time, we hope, there will be courses offered in Business Engineering leading to a degree as in the Engineering College for the present courses.

Now is the time for the preliminary work to be done on the Engineering Dance. Unless we wish an Engineering Dance similar to that of last year, we must get together and boost it at once. The whole University must be let to know that there is to be such a dance—not one, perhaps, of the same type of former functions as the "Prom" or the Military Ball, but yet one which any man in the University will be eager to attend.

The next issue of the *Technograph*, dated January, 1915, will be devoted exclusively to the "Safety First" movement in the engineering. We have been promised articles and illustrations from the leaders of this work all over the country, among whom are included the heads of the departments in some of the most prominent railroads and manufacturing companies. Any suggestions that anyone may have to offer will be gladly considered, as we hope to make this the largest and best issue of the year. Mr. Bruce Benedict, Director of the Mechanical Engineering Shops and leader of the "Safety First" campaign about the University, has kindly consented to act as Consulting Editor for this issue.

COLLEGE OF ENGINEERING NOTES

Assistant Professor J. I. Parcell resigned from the Civil Engineering department to go to the University of Minnesota, where he takes charge of the structural engineering department.

Professor Chas. A. Ellis comes to us from the University of Michigan, where he has been Assistant Professor for four years. Mr. Ellis has had ten years' experience in structural engineering.

Robin Beach, instructor in the General Egineering Drawing department, has gone to the College of Texas as an instructor in electrical engineering. Mr. C. A. Atwell, a graduate from the University of Nebraska, takes his place as instructor in the G. E. D. department.

Mr. A. C. Callen takes the place of L. E. Young, who resigned last year, in the Mining Department. Mr. Callen is a graduate of Lehigh University, where he was an instructor in Physics for two years. He has also had considerable experience in mining engineering, having taught metallurgical construction and mine design.

Former Assistant Professor J. M. Bryant of the Electrical Engineering department has gone to the University of Texas, where he becomes head of the Electrical Engineering department.

The E. E. department has added to their staff Mr. John W. Davis, a graduate of Cornell.

Mr. H. I. Smith was appointed resident mining engineer by the U. S. Bureau of Mines to fill the office held by J. T. Ryan, who resigned July 1. Mr. Smith is a graduate of Pennsylvania State University and will act here as the government representative in the investigation into Illinois mining conditions being run under co-operative agreement by the U. S. Geological Survey and the U. S. Bureau of Mines.

DEPARTMENT NOTES

C. E. NOTES

The C. E. club has departed from its former policy of having outside speakers come and give talks once a month. This year the talks will be given by members of the club and the faculty who have had charge of work which would be of interest to civil engineers. There are a number of men in the club who, having had charge of responsible engineering work, would give their experiences and create discussion which would be beneficial to all.

The new officers of the C. E. club are:—

President—F. W. Panhorst, '15
Vice President—L. D. Knapp, '15
Secretary—P. W. Freark, '16
Treasurer—A. Norberg, '15

The annual feed of the C. E. club was held in the Engineering lecture room and the club's reading rooms. The meeting was well attended and considered a complete success. The purpose of the feed was to interest the freshmen C. E.'s in the work of the club. Mr. F. W. Panhorst presided and Professors McDaniel, Ellis, Wiley and Baker, H. J. Burt, C.E. '96, and Mr. Turley, C.E. '13, gave short talks. Smokes were dispensed on account of a rule prohibiting smoking in University buildings.

Mr. R. L. Morrell, '15, spoke on "The College Man in Business," at a meeting held by the C. E. club on Oct. 15.

"The Manufacture of Portland Cement" was discussed on November 15 by P. W. Freark. Mr. Freark tested cement for the State Highway department at the Marquette Portland Cement mills in La Salle, Ill., during the summer vacation.

M. E. SOCIETY

The Mechanical Engineering Society held their initial meeting October 2, at Y. M. C. A., and was in the form of a feed. The purpose of the feed was to bring out all mechanical engineering students, to get better acquainted, and have a good social time.

The feed was well attended by both members of the faculty and students. Eats, which were served in great abundance, consisted of cider, doughnuts, apples, and crackerjack. Short talks were given by several members of the faculty, which were short, snappy, and to the point. Several suggestions for the betterment of the society were given.

October 9, the society met in the M. E. Lab. As part of the program, Prof. Goodenough gave a very interesting talk on "Short Cuts in Calculations". It has been planned to have several meetings the coming semester, at which both members of the faculty and students shall take part.

New equipment has been added the past summer to the M. E. department for the betterment of the courses. In the shop laboratories, a new Hendley centering machine, manufactured by Manning, Maxwell and Moore, has been placed in the machine shop, increasing the efficiency of the shop by lessening the time to center stock. In the wodshop a Gardener disc grinder, manufactured by the Gardener Disc Grinder Co., increases the efficiency of this department. In all departments of the shop laboratories, "shop efficiency" has been added to class instruction, and equipment for such instruction.

The most interesting part to the M. E. student is the addition to the power station. Two Babcock and Wilcox boilers are being installed, which will be ready for use in the near future. This addition will double the present boiler capacity of the power plant. With the installation of the boilers, a link belt is being installed for conveying coal from beneath the cars directly to the hoppers, which in turn will feed the automatic stokers. Scales are also being installed near the power plant, large enough to accommodate a loaded railway car.

Mr. Leroy Alonzo Wilson, M.E., M.M.E., has been appointed assistant on the staff of the Engineering Experiment Station, in the department of mechanical engineering.

Mr. Horatio Sprague McDowell, M.M.E., was appointed instructor in mechanical engineering.

Mr. Edwin Frank, B.S., has been appointed instructor in mechanical engineering.

Mr. James H. Hogue has been appointed instructor in foundry practice.

Mr. Gustav H. Radebaugh is now in charge of the machine shop.

MINING NOTES

The Student Branch of the American Institute of Mining Engineers started out this year by a big "get together" at the house of Prof. Stoek Oct. 6. At this meeting officers for the ensuing year were elected. The officers for the year are:

President—R. A. Strong
1st Vice President—J. H. Grytner
2nd Vice President—A. R. Morris
Secretary—D. C. Johns
Treasurer—H. C. Wilson

A number of the faculty were present and summer experiences were related.

The Mining society inaugurated its work for the year by a smoker given at the Y. M. C. A. Oct. 21. A large number of members were taken in and plans were discussed for the year. A number of interesting talks were made, among which was a humorous account by Prof. Stoek of his experiences in Germany during the excitement following declaration of war.

Mr. Porter, a former student of Illinois, who has just returned from South America, gave a most interesting account of mining in Chili and Peru. Mr. Perry, of the present graduating class, related a few of his experiences in the Homestake mine at Leed, South Dakota, in a most entertaining manner. Smokes and eats were very much in evidence and a most enjoyable evening for everyone resulted.

It is the intention of the Mining society to stimulate an increased interest in mining among the students in the college by having meetings at which both the faculty and students may meet on a plane and become better acquainted. The meetings have been changed from afternoon to evening, by which arrangement it is expected to make it possible for everyone to attend. The Program Committee has promised some interesting programs for the year, and it behooves everyone interested in mining to attend these meetings.

THE RAILWAY CLUB

The Railway club is displaying again this year the same degree of activity and progressiveness which has characterized the club since its organization. So far this semester two meetings have been held, the first being an open meeting to which all students in the railway courses were invited. "Eats", consisting of sandwiches, apples, marshmallows, and lemonade were a rather important feature of this first gathering. Short talks concerning the aims and work of the club were given by President Pike, Professor Dewsnup, and Professor Schmidt. A very large percentage of those taking railway work were present, and a large number of these were subsequently enrolled as members. The membership fee this year is the same as before, i. e., one dollar and a half, this including, of course, a subscription to the *Technograph*.

On October 23 an "Experience Meeting" was held, at which some of the members of the club related a few of their experiences during the summer vacations.

At present, plans are being perfected by President Pike for a series of talks to be given before the club during this semester, also plans for a smoker are under consideration. It is the intention of the officers of the club to make this a banner year in the history of the organization, and from the interest which has already been shown by the members, it is certain that their intention will be realized.

E. E. SOCIETY NOTES

The E. E. society started out with its semi-annual "feed" on October 2. It was said to have been the best attended "feed" ever held. The number of memberships which were taken in during the evening ran very near the one hundred mark, which, however, was not as high as was expected.

Mr. J. W. Davis, who is a new member of the electrical engineering faculty, gave a talk, before and after which he was occupied in getting acquainted. Mr. Davis is a graduate of Cornell and has done graduate work at Harvard. Prof. Paine gave an interesting talk to the newcomers in regard to the department. Mr. Jones, of the Physics Department, who is the only one in the department who is in line for the Doctor's degree this year, greeted the men with a good talk. Mr. Richards, Acting Dean of the College of Engineering, gave the society a good "boost". We were very fortunate to have his presence the greater part of the evening, as he was to speak at the M. E. Smoker the same evening. Mr. J. Simonich, '14, who is doing graduate work this year, spoke on the possibilities of having an E. E. show this year.

The matter of the E. E. show has been under much discussion thruout the student body as well as the faculty and council. At the first regular meeting of the year, after a heated discussion, the Society voted to petition the council to permit the Society to hold the show. Nothing definite has been obtained in regard to the matter at this writing.

The matter of a pin for the society met with much agitation, and after a great deal of debate, the proposition was dropped.

It is the policy of the society to continue its affiliation with the A. I. E. E. as was decided upon last year, and it will take charge of alternate meetings. This proposition seems to be gaining much favor with both the faculty and the society members, and will, therefore, probably be adopted as standard.

The society will start a canvass for membership immediately, and hopes to surpass any previous records.

RALPH L. HERMANN, *Pres.*

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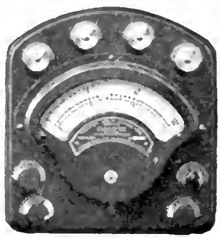

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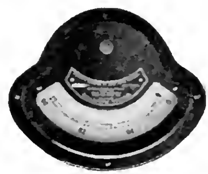

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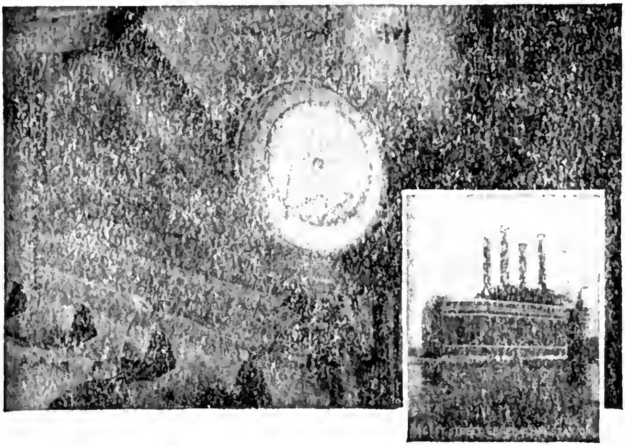

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The Technograph

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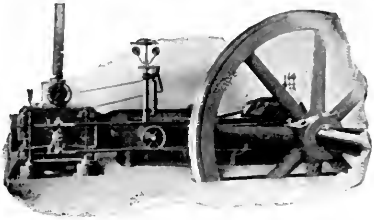

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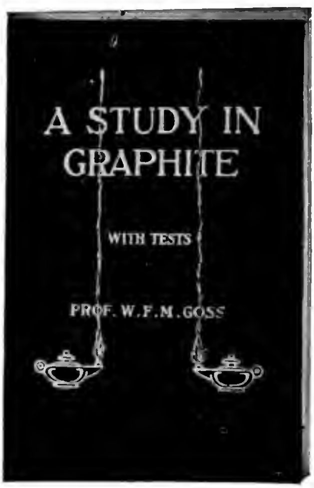

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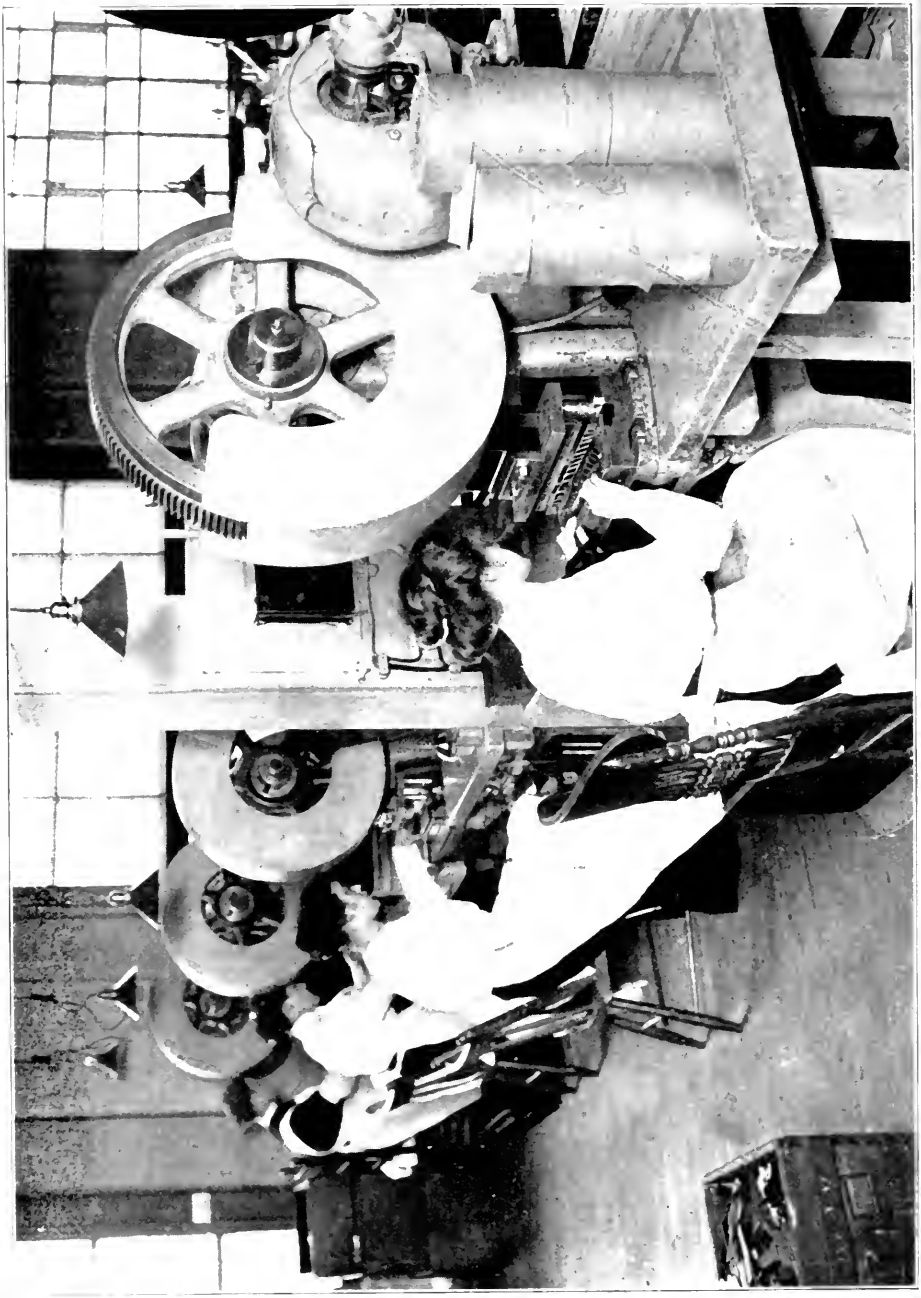

The Technograph

Vol. XXIX | January, 1915 | No. 2

SAFETY FIRST BY THE STATE OF ILLINOIS

OSCAR F. NELSON
Chief State Factory Inspector

The State of Illinois is among the pioneers of the "Safety First" movement.

In its present stage the movement is very clearly an engineering problem and has brought a new profession in the fields of endeavor—the industrial or safety engineer.

The conviction that accidental injury can be eliminated to a considerable extent and, because it can be, should be, is now so widespread and clearly outlined that there is little need for the agitator's eloquence. On all sides the question is asked—"How can this be accomplished?" The engineering answer is, organization. The correct use of this word may not be at once apparent. By way of illustration—we need a machine for a certain purpose. The materials, the mechanical principles, the workmen's dexterity, are all in existence. These must be combined by the skill of the engineer, organized, in other words, so that the parts of the ultimate mechanism shall work in balanced harmony.

The fundamental principle of all organization for "Safety" is that it must begin at the top. The top, in my judgment, is the governmental agencies which are supposed to control these matters. "Supposed" because a coercive principle rather than a constructive has been built upon. The latter idea has been adopted in Illinois and bespeaks of the wonderful achievements attained by this Department.

The Illinois Department of Factory Inspection projects its ideas and wishes in the following three ways:

First, by diagnosing an employer's plant and informing him of conditions he must remedy.

Second, by taking him into consultation and showing him how the existing dangerous conditions can be rendered safe.

Third, by the use of exhibits and illustrated lectures to educate the employer in the demand of the law and in the need of avoiding every possible point of danger.

The wave of "Safety First" which is spreading over the country at present was inaugurated about ten years ago. Eight years prior to that time Illinois had laid its foundation in this beneficial endeavor, when the 40th General Assembly, in 1897, passed and approved a bill to compel the using of blowers upon metal polishing machines, thereby conserving the health of the workmen who had been forced to breathe the fine emery dust thrown off by the highly-speeded wheels. This law clearly established one of the most essential principles of "Safety First" that of guarding the health of a portion of our industrial population. Every workman has a moral, as well as a legal right to earn his daily bread in a pure atmosphere. This was the extent of the law. Prior to the enactment of this law this trade was considered so hazardous that the Insurance Companies would not take the risk of granting the men engaged in work around emery wheels or belts a life insurance policy.

Having made the start in 1897 by the enactment of the "Metal Polishers Law" Illinois continued its efforts to secure further safety in industry. Thus, in 1907, the 45th General Assembly passed a law to provide for the protection and safety of persons in and about the construction, repairing, alteration, or removal of buildings, bridges, viaducts, and other structures.

With the modern skyscraper new methods in building trades developed. Danger to employes on such structures increased correspondingly and legislative means had to be adopted to provide for the best protection. This law requires that scaffolds, hoists, stays, ladders, supports or other mechanical contrivances be erected, constructed, placed and operated so as to give proper and adequate protection to the life and limb of any person engaged on same and to prevent the falling of any material that may be used or deposited thereon. In addition hereto the laws covers almost every possible dangerous feature about a building or structure. For example, safety rails must be provided on scaffolding or staging in order to prevent a workman from falling; signal systems of communication must be provided in case where hoisting machinery is operated; public streets must be barricaded where material is being hoisted over same; temporary floors must be laid on steel structures; and many other detailed provisions are enumerated all with the one idea, namely, to protect the man on the job and to permit his services to continue as a bread winner to his family or other dependents.

The passage of this law in 1907 gave the safety first propaganda by the State additional impulse, so much so that by the year 1909 the 46th General Assembly passed the most comprehensive law ever presented to a legislative body on this subject. The action taken by the 46th General Assembly resulted in what is commonly termed as the "Health, Safety and Comfort Law". The purpose of this law is implied in its title, i. e. to provide for the health, safety and comfort of employes in factories, mercantile establishments, mills and workshops.

The more salient features of this law are enumerated here.

All machinery when in operation is dangerous, and should be considered so by the operator. It should be so protected as to offer the least possible chance for injury to those who operate it.

All set screws, or other projections on revolving machinery shall be countersunk, or otherwise guarded when possible.

Means shall be provided, and placed within convenient reach for properly stopping any machine, group of machines, shafting, or other power transmitting machinery.

Machines must not be placed so closely together as to be a serious menace to those who have to pass between them. Passageways must be of ample width and head room, and must be kept well lighted and free from obstructions.

All hatchways, elevator wells or other openings in the floors must be properly closed or guarded.

All premises must be kept in a clean and sanitary condition.

Ample and separate toilet facilities for each sex shall be provided, and toilet rooms must be kept clean, well ventilated and well lighted.

Food must not be taken into any workroom where white lead, arsenic or other poisonous substances or gases are present under harmful conditions.

Proper and sufficient means of escape, in case of fire, shall be provided, and shall be kept free from obstructions.

Poisonous and noxious fumes or gases, and dust injurious to health, arising from any process, shall be removed as far as practicable.

No employe of any factory, mercantile establishment, mill or workshop shall operate or tamper with any machine or appliance with which such employe is not familiar and which is no way connected with the regular and reasonable necessary duties of his employment, unless it be by and with the direct or reasonably implied command, request, or direction of the master or representative or agent.

Reports of accidents causing the loss of fifteen or more days consecutive time must be sent to the State Factory Inspector between the fifteenth and twenty-fifth of each month, and immediate notice of the death* of any employe resulting from an accident or injuries must be sent to the same office.

The subject of accident prevention depends largely upon the method employed of securing reports of accidents. Only from reports of accidents can we hope to study the sources of injuries and death, and accordingly seek to prevent their reoccurrence.

From the moral and the humanitarian standpoint, the prevention of preventable accidents is not an altruistic favor to anyone. To eliminate pain suffered by injured men and their possible lessened enjoyment of life, to reduce sorrow felt by the people to those killed or badly hurt, to diminish the misery of the world, is the plain duty which admits of no argument. It is simple justice.

Viewed from the economic side, whether broadly or narrowly, the necessity for accident prevention should be just as evident.

The brains and brawn of a nation are its greatest asset, far greater than any of the material resources which we are now so carefully conserving. Any drain upon this asset is a calamity, any avoidable dissipation of it, a crime.

Industrial accidents mean a distinct decrease in the productive power of the community, future as well as present. Besides destroying and curtailing the working capacity of the injured men themselves, they result in loss of educational opportunity to the next generation, and consequently in its lessened usefulness thruout life.

They are also a drain upon wealth already created. The money which is paid out in compensation or damages, great as it is in the aggregate, is only a part of this drain, I might say, but a small part. When a workman is thus withdrawn from the wage-earning class, there are, sooner or later, many other calls upon accumulated funds. The economic balance in the workman's home is disturbed. There is medical expense; possibly, the cost of hospital care; possibly too, the expense of litigation. The injured man may have to be supported in his old age. It may be necessary to care for dependents. In one way or another, there is sure to be a demand that the loss caused by the workers inability to continue doing his full part in the world's work be made up. It is immaterial how this demand is met, whether by the worker's own savings, by mutual benefit associations, by

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*At present only such firms as have not elected to accept the provisions of the Industrial Board, created by the 48th General Assembly, report under this act.

insurance, by public or private charity, by taxation; it is economic waste.

The waste due to industrial accidents is evident, too, in another way, which comes closer home to the employer who stops to consider what accidents cost him, or the consumer through him. This is in the diminished efficiency of the plant.

The occurrence of an accident distracts other works in the vicinity, stopping their productivity for the moment at least and curtailing it for some time. If the accident has distressing features, it may be days before those who saw or heard of it regain their normal rate of working speed. Frequently there is a complete stoppage of work on account of an accident.

Then, there is the loss due to the disability of the injured employe, the diminished productiveness while the place of one temporarily disabled is held open for him or a new man is being trained to take the place of one permanently disabled; the time which a foreman or other worker has to take from other productive employment in order to give such training; the defective work which a new hand turns out; the scrap loss which he often causes.

All such interferences with the ordinary course of a plant's work, cause a loss of efficiency which is distinctly measureable in cold dollars and cents. An idle machine, or one not working to its full capacity is an expensive luxury, moreover, the overhead expenses of the plant are running on just the same, but without the same degree of offset as if the accident had not occurred.

In view of these facts the State of Illinois has stretched out its helping arms and seeks to cut down this wholesale list of injuries and deaths. While Illinois practically laid the foundation of Safety work in this country, I believe that the chief reason for our national backwardness in this important work, aside from our absorption in material development, is that what is anybody's business or everybody's business is pretty sure to be nobody's business. To use a slang phrase, the prevention of accidents has been too much a case of "Let George do it."

Speaking of the safeguarding of machinery, very much indeed can be done to promote safety in the designing of machinery and its equipment with guards at the time of its manufacture. Not only can safeguarding often be done better then, but it can be done more cheaply. Where a machine is built without safeguards, either in fact or in mind, it is sometimes impossible to provide effective guards for gears and other dangerous moving parts because of lack of clearance; whereas slight changes in the original design would have made good guards possible, and they could have been provided at practically a negligible cost.

But one of the most important features of safety work is the education and co-operation of the workmen. The man who has been working at his trade for years is set in his ways and intolerant of change. He clings to his trade practice like the nobleman of old to his honor. Not only does he instinctively object to any variation from the working methods which he learned in his youth, but in many cases he is firmly convinced that any departure from reckless ways would cause him to lose caste among his fellows. There are many thousands of these men who no safety campaign even by the direction of the State will influence in the slightest degree and whose opposition to change also has an unfortunate effect upon others who, but for their attitude might be properly influenced.

Though these men cannot be changed, they will ultimately be replaced by a new generation, and this new generation can and should be made very different from them. Education of the rising generation of workmen is looking well toward the future. It will be a slow process, and the beneficial results of it will become manifest only by degrees and in the course of time, but eventually it cannot fail to have far-reaching effect upon the measure of accident prevention attainable. It will produce a steadily increasing number of workmen who not only will tolerate safeguards and will cheerfully use them, but who from force of habit, will be addicted to safe methods of working.

The "Health, Safety and Comfort Law" proves its belief in the education of the workmen by prescribing a poster which must appear in every factory containing a synopsis of the law and elementary instruction in safety first. These posters are printed in eighteen foreign languages and are distributed free of cost.

It is of interest to note how our industrial population has changed. This is particularly true of those places where great steel mills, iron foundries, blast furnaces and coal mines are located. In these districts where originally native-born American and the older immigrant races predominated, today there are men of all nationalities. This change has gone on so extensively and has affected a great variety of industries.

It might be pointed out that early immigration to this State was from Western and Northern Europe. It included, in large numbers, the Germans, Swedes, Norwegians, English, Irish, Welsh, Scotch and Dutch nationalities. Until the early 80's practically no representative of other nationalities came to this State. After that time, began to come a few Poles, Lithuanian and Slovak. The number was not great until about the beginning of the 90's. Then followed Italian, Hungarian and other Eastern and Southern European nationalities, until by 1900 the number of these had increased so greatly as to predominate in the stream of immigration. Since 1900 the earlier type has readily decreased, while on the other hand the eastern and southern Europeans have continued to come in rapidly increasing numbers.

This transition is largely due to the fact that the foreign-born laborer of the newer type is willing to accept employment at a lower wage than the native-born employe. He is not encumbered with a family like the native laborer, is able to live more cheaply, and lacks the experience to command as high a wage. Although it is true that the native-born has ceased to work at heavy labor, it is significant that many Germans, Swedes, Irish and English are employed as managers, superintendents, and foremen, i. e. they have gone into the semi-skilled pursuits.

Illinois, particularly the City of Chicago, is a melting pot of all nationalties. Besides those enumerated above, we find scattered throughout our industrial plants Russians, Bulgarians, Roumanians, Rutherians, Syrians, Armenians, Macedonians, Croatians, and Servians.

The following table shows the results of inspections according to the provisions of the Health, Safety and Comfort Law since taking effect of the same to June 30, 1914.

Classification of Orders Issued to Install Safety Appliances and to Correct Other Defects According to the Provisions of the Health, Safety and Comfort Law. Since Enactment of Law Jan. 1, 1910, to June 30, 1914.

	Total for Entire State	Chicago and Cook County	Outside Chicago and Cook County
Number of orders issued	117,136	72,300	44,836
Administrative:			
Post Notices	2,731	1,679	1,052
Report accidents	1	....	1
General Orders	207	83	124
Building:			
Exits	2,462	1,833	629
Doors open outward	902	806	96
Safe Treads on Stairs	963	831	132
Stairs and Platforms	2,630	1,274	1,356
Properly fence openings	581	337	244
Elevator Gates	1,598	1,148	450
Elevator Cabs	1,318	989	329
Elevator Safety Devices	125	56	69
Adequate Lighting	277	244	33
Overloaded floors	180	102	78
Passageways	1,538	927	611
Dangerous Places	1,153	742	411

	Total for Entire State	Chicago and Cook County	Outside Chicago and Cook County
Sanitation:			
Toilets	4,211	2,796	1,415
Wash and Dressing Rooms	437	308	129
Dining Rooms	105	91	14
Seats for Females	72	64	8
Temperature	15	15	....
Ventilation	1,136	858	278
Dust and Fumes	1,056	670	386
Sanitary Rooms	1,560	1,320	240
Fans and Blowers	648	487	161
Power:			
Disengaging Devices	2,012	1,103	090
Signal Devices	417	222	195
Belt Shifters	4,640	3,600	1,040
Switches	81	35	46
Boiler and Enginer Room	399	216	183
Weights and Couplings	290	155	135
Dangerous Machinery:			
Hydro-Extractors	665	369	296
Motor & Electrical Appl.	772	602	170
Band Saws	2,029	967	1,062
Circular Saws	2,414	1,261	1,153
Cross Saw	42	1	41
Planers	246	91	155
Shapers, Stickers	543	255	288
Jointers	1,065	510	555
Sanders	89	74	15
Punch and Drill Presses	1,581	963	618
Emery Wheels	2,651	1,434	1,217
Rolls	460	238	222
Exposed Containers	106	64	42
Trip Hammer	21	16	5
Dangerous Machinery Parts:			
Fly Wheels	9,126	5,319	3,807
Spindles and Shuttles	703	633	70
Planer Beds	719	438	281
Pipe Machine	23	18	5
Gears	19,320	11,170	8,150
Belts and Pulleys	35,894	20,608	15,286
Sprocket Wheels and Chains	3,182	1,568	1,614
Shafting	2,477	1,348	1,129
Set Screws and Bolts	11,039	5,854	5,185
Electric Wiring	24	15	9
Cranes	51	18	33
Cutters, Splitters	3,981	3,975	6
Total	130,029	79,038	50,991

Total Number of Danger Points upon which Corrective Orders were Issued.

This law has been in operation three and one-half years, during which time about 15,000 establishments have been visited. These inspection tours brought about the issuance of over 117,000 official orders to safeguard danger points about machinery or to correct defects in building, lighting, sanitation and ventilation.

During the time that this law has been in operation 130,029 number of hazardous points about the places inspected have been ordered guarded or protected. It will be noticed that "Belts and Pulleys" to the number of 35,894 ranks first in this long list of danger points in manufacturing establishments, "Gears" running second with 19,320 orders and "Set Screws and Bolts" third with 11,039 orders. Attention is here called to the number of "Gears" and "Set Screws and Bolts". The figures represent the number of orders issued to do away with such dangerous machinery parts; it does not mean that 19,320 separate or individual gears have been ordered guarded, but that 19,320 groups or sets, as happened to be located in an establishment, were ordered to be rendered free from danger. The same applies to the figures opposite "Set Screws and Bolts". This may be expressed with more emphasis by stating that one establishment may contain several thousand set screws or several hundred gears.

In brief this discussion covers the work accomplished under the Health, Safety and Comfort Law. This law received an excellent companion, when along with the idea of safety the State of Illinois adopted the slogan of prevention. This movement resulted in the passage of the "Occupational Disease Act" which was enacted by the 47th General Assembly and became effective July 1, 1911.

The Occupational Disease Act has for its purpose the preventing of such ailments which might be contracted in the course of employment. This law aims particularly to reduce sickness in the trades which occasion dust, fumes, gases or where harmful substances are used in the process of manufacture. Especially dangerous are the paint making and white lead industries, manufacturing of tinware, smelting and refining of metal, litho transfers or decalcomnias on china ware, making paris green, manufacturing of car seals and bearings, and preparing batteries.

The campaign for the prevention of occupational diseases has been carried on in Illinois for the past four years entirely along educational lines. During that time only five cases were prosecuted in Courts, because this Department resorts to prosecution only in extreme instances.

*The prevention of occupational diseases depends largely upon the workers themselves. The law makes it incumbent upon the employer to provide free of cost soap, towels, nail brushes, hot and cold water, shower baths, and clothes lockers for street and working garments. However, in spite of all these precautions we find the number of cases of illness too numerous. At present 251 firms are reporting monthly to this Department on the physical condition of their employes. A compilation of these monthly reports discloses the astounding fact that in the manufacture of paris green six out of every hundred employes suffer from arsenical poisoning; in the making of tinware eleven out of every hundred employes contract lead poisoning; in the car seal and bearing industry lead poisoning claims twelve out of every hundred employes, and in the transfer process of decalcomanias on china ten out of every hundred employes become victims of poisoning by lead.

We have now arrived at the last piece of this class of leglislation. The 48th General Assembly passed an act known as the "Wash House Law". This law provides that the owners of steel mills, foundries, machine shops, or other like businesses shall maintain sanitary washing rooms with running hot and cold water, and lockers in which employes may keep their clothing. These rooms must be sufficiently heated during the cold weather to permit employes changing their clothing.

The object of this law is to provide washing facilities for employes who become covered with grease, smoke, dust, grime and prespiration. Permitting these men to leave their place of employment without washing and changing their clothing would endanger their health and make their condition offensive to the public.

From the human interest side the results of this law enfold wonderful stories. Upon the passage of this law most employers laughed at the idea of providing washing facilities for their employes, claiming that these would not be made use of, if placed at the disposal of the men. However, this Department insisted upon the installation of these facilities and is proud to report, that the men have become eager to avail themselves of a washing and general cleaning-up before going to their homes. The effect of the law has been more far reaching than was anticipated. At first the men were timid and did not accept the idea of washing. It required just one or two to lead the way, and the trim condition of the leader aroused the others to strive

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*See "Relation of Certain Industries to Disease", May, 1914, Technograph.

for a tidy appearance. But what is even more to be admired is the manner in which this law reflected its benefits in the home.

Having been educated in the rudiments of cleanliness at the factory and having established a certain standard among the men, the individual worker returns to his home which still remains in the slovenly, untidy condition as of previous days. However, the factory or mill convert to cleanliness sets in to inaugurate the same changes in his home. Cleanliness becomes the slogan in the home of the employe and every member of his family must conform to the standard which he has adopted in his place of employment. This change of conditions was gained from first hand observations in the vicinity of several of the largest mills and foundries in Chicago.

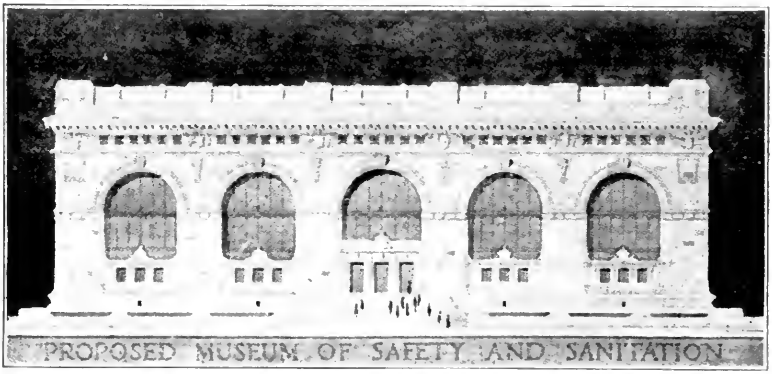
The suggestive stages of this progressive, beneficial legislation projects the part which Illinois had played in this history of factory legislation, especially that of accident prevention and safety first.

I believe that after educating the employes generally in the use of good judgment and care at all times, that the question of fixed standards of safety relating to machinery will become the essential one. I also believe that the ideal way to achieve the installation of safety devices is to have them incorporated in the machine where it is manufactured. Similar views are held by a great many safety engineers and other persons who have given the subject thought. But it is likewise agreed that the standardization of safety devices is one of the knottiest problems that have yet confronted those who are striving to protect workers against mishaps.

SAFETY, ALWAYS

WILLIAM H. TOLMAN, Ph.D.
Director American Museum of Safety

Realizing that the accidents to the general public, but especially to children, on city streets were increasing at an alarming rate, The American Museum of Safety, in the Summer of 1912, decided that an educational campaign among the children themselves would be the best means of preventing these accidents and of reducing the waste of human lives and limbs. Accident prevention is primarily a matter of education, and the hope for sound and efficient citizens in the future lies in training the children of



Courtesy of the Norton Co.

the present generation to think and act along lines of safety and caution on the streets and in their homes.

In the summer of 1912, Mrs. W. H. Tolman, volunteering services to the Museum in the absence of the Director who was conducting research work abroad, requested from the Board of Education permission for classes from the vacation schools in charge of their teachers to meet at the Museum for talks and demonstrations on accident prevention, with particular reference to avoiding the perils of street traffic. Dr. William H. Maxwell gave the necessary authority.

The responsiveness of the children and the indorsement by their teachers of the talks on safety and caution with demonstrations of devices clearly indicated the success of the experiment. The children eagerly absorbed the instruction given them and answered with intelligence the questions asked with a view to determining their understanding of the uses and purposes of the various devices explained to them.

In the fall of 1912 The American Museum of Safety offered to carry its work into the schools, that all of the seven hundred and eighty-five thousand public school children might receive the benefits of this special instruction. The Board of Superintendents of the public schools of New York City were heartily in favor of the plan, and after formal deliberation submitted a resolution to the Committee on Elementary Schools, asking permission of the Board of Education to co-operate with the museum for the purpose of reducing accidents among the school-children.

This resolution was promptly indorsed and formally adopted by the Board of Education on November 13, 1912, and reads as follows:

> *Resolved*, That permission be, and it is hereby, granted to the Board of Superintendents to make arrangements with the American Museum of Safety for co-operation between the schools and said museum, for the purpose of reducing the yearly loss of life and limb among the children attending the schools of the city of New York.

On December 10, 1912, the Museum began its safety campaign in the regular public schools. A Department of Education was organized by the Museum under the chairmanship of Mr. A. A. Anderson, and with the following members: Mr. Martin H. Insull, Mrs. Helen Hartley Jenkins, Mr. Albert R. Shattuck and Dr. Gustave Straubenmuller. The committee availed itself of the volunteer services of Mrs. Tolman who actively entered the schools as a lecturer and trained other lecturers to assist in the work.

Museum lecturers have visited the various schools according to schedules. The little stories of accidents and brief talks on safety have been illustrated by means of charts and models of safety devices specially prepared for this educational work.

The pupils have met usually in the assembly-room. Sometimes these audiences have been very large, numbering as many as twenty-five hundred boys and girls. At the close of each talk "Safety buttons", bearing the insignia of The American Museum of Safety, were left with the principal of the school for distribution among the children. The wearing of this makes the child a member of the Museum's Safety League and serves to keep the lessons of the talk fresh in mind. Badges of a little better quality and of a different design have been presented to the teachers and to the pupils of the higher grades.

The buttons have been followed by safety leaflets, or stories, on the special dangers of street-cars, electricity, gas, automobiles, and matches. Both text and illustrations are adapted to the comprehension of the children, who have appeared to be delighted with them.

Not only were the public schools included in this educational campaign for safety, but also the parochial and private schools which add at least one hundred and fifty thousand boys and girls to the seven hundred and eighty-five thousand children in the regular public-school system. To date, the Museum lecturers have reached 412,496 children in the public and parochial schools of Manhattan and Brooklyn. A similar campaign was started in Buffalo in 1914.

In some of the densely populated sections conversation with the principals of the schools has disclosed the fact that many accident cases are "faked" by parents, who deliberately expose their children to danger or swear that the children have been injured, securing the assistance of false witnesses and of shyster lawyers to substantiate their claims for "damages" upon the public-service corporations. In some instances teachers have been approached by these "lawyers" for testimony to strengthen the claims, even when the testimony desired bears not the slightest relation to the facts as the teacher knows them.

In the talks given by the Museum lecturers honesty and integrity of character are strongly impressed upon the children in connection with their actions upon the streets. Thus far every principal has been found to be in heartiest accord with the work, believing that it will have beneficial results, not only with the children, but upon the neighborhoods from which they are drawn.

In some of the schools of the lectures safety stories were used as a basis for composition work. In one school the leaflet was translated into Italian for the benefit of the grown-up members of the family at home.

In a certain Brooklyn kindergarten, a game called the "Safety" game was instituted as a result of the talk on street dangers. The children are delighted with this game and play it with great zest. Four children assume the role of the "trolley car" supposed to be running in the middle of the street, while their playmates "look up the street and down the street" before attempting to cross. The action of the game and the chanting of the cautions in the sing-song fashion of the kindergarten have impressed the safety rules upon the plastic minds of the little ones in a manner not easily to be eradicated.

Still other schools have used the safety ideas in short plays written by the pupils in connection with their composition work. The warnings emphasized by the lectures have been brought out very cleverly by some of the children, showing how well they have grasped and absorbed the instruction given them.

The Commercial High School of Brooklyn was reached late in the season, in fact after the examinations were concluded and attendance was no longer compulsory. So great was the interest in the subject of safety, however, that, out of an enrollment of 2,200, fully 1,500 of the pupils voluntarily came back to hear the lecture and to see the demonstrations. In this case, no restrictions as to time were imposed and the lecturer was at liberty to enlarge upon the theme of safety with special reference to accident prevention in the industrial world these children are about to enter.

For the cumulative effect of a concerted effort to drive home a lesson of safety and caution to every child in the greater New York the suggestion was made in March last by Mr. Arthur Williams, President of The American Museum of Safety, that every school-teacher in the city should deliver a safety talk on the same day and at the same hour, in the classrooms.

Mr. Williams's idea met with cordial response from the Board of Education, as attested by this letter from its superintendent:

DEPARTMENT OF EDUCATION

The City of New York
Office of
The City Superintendent of Schools

500 Park Avenue, March 7, 1913.

Mr. Arthur Williams,
President, American Museum of Safety,
29 West 39th Street, Manhattan.

Dear Sir—The Committee on Elementary Schools and the Board of Superintendents have approved your suggestion that on the same day and at the same hour in every public school in this city each teacher shall give a talk on "Safety".

The Board of Superintendents has selected April 4th at two o'clock as the time when these lectures shall be delivered, and I have been requested to notify the principals of the schools to this effect, and to transmit with the letter of notification the text of the lecture.

Yours very truly,
WM. H. MAXWELL,
Chairman, Board of Superintendents.

Mr. A. A. Anderson, Chairman of the Museum's educational section, had a reading lecture prepared, entitled "Safety and Caution", as a suggestion for the teacher to read to the class, or to assimilate as the basis for a talk to the pupils. No particular anecdotes were added, as it was thought each teacher would recall many an illustrative fact which could be used in reinforcing a special point in the text.

The practical result of this concentrated effort was that about 18,000 teachers were supplied with the leaflets and nearly 800,000 school-children reached simultaneously in the safety talk on April 4th, 1913, designated as "Safety Day".

This innovation was widely and favorably commented upon by the press of New York and other cities, and the rules formulated by the Museum for the protection against the dangers of the street have since that time appeared in the leading newspapers from the Atlantic to the Pacific Coast.

One extension of the safety crusade was the organization of a safety patrol in P. S. 159, Brooklyn.

This Patrol consists of twelve boys from the upper grades selected by the principal, whose duty it will be to guard the smaller children from danger at the street crossings before and after school and see that the little ones get safely across. They will have a roving commission, and in addition to their duty at the street crossings will look out for the safety of the children while at play.

Every Safety Patrol will have a sergeant, probably elected by the other boys on the patrol, who will serve for one month. The members will wear special badges of bronze and enamel provided by The American Museum of Safety. The sergeant will be required to send a stated report on the work of his patrol to the Museum, where a "blotter" will be kept of all the happenings and typical cases printed in the Bulletin of the Museum.

The Brooklyn Rapid Transit Company, solicitous for the street safety of the children of Brooklyn, generously cooperated with the Museum in the Children's Crusade by providing the funds for 300,000 Safety League buttons, 600,000 safety story leaflets, badges for the principals and the safety patrols and the special reading lecture. In addition, they provided ten small model trolley cars for demonstration use by the lecturers and a delivery wagon for taking the exhibits from school to school. Safety posters were conspicuously displayed in all of the Brooklyn Rapid Transit cars.

A set of practical rules is incorporated in all of the safety pamphlets, and while these rules are presented to the children first, they are equally applicable to their older brothers and sisters and their parents.

NEVER jump on or off a moving car.
NEVER stand or sit on the car step; nor put your head or hands out of the car window.
NEVER get off a car facing the rear; with the left hand, take hold of the grip handle; left foot to the step, right foot to the ground; face forward.
NEVER fail, on leaving a car, to look out for passing wagons and automobiles.
NEVER run in front of a passing car.
ALWAYS in passing behind a car, look to see if another car, automobile or wagon is coming from the opposite direction.
NEVER "Hitch on" or steal rides behind street cars and wagons.
NEVER play on the car tracks.
ALWAYS look both ways before crossing the street.
NEVER cross a street except at a regular crossing.
NEVER take chances. ALWAYS SAFETY.

The Museum feels that great credit for the success of the safety crusade is due to the personal and loyal cooperation of principals and teachers; almost without exception they have expressed their belief in the work, recognizing the reinforcement it will bring to their own efforts to induce their pupils to think for caution and safety.

In Manhattan, the Consolidated Gas Company generously contributed funds and provided a wagon with an attendant for the delivery of exhibits among the schools. Other contributors to the educational work were: Mr. A. A. Anderson, Mrs. Helen Hartley Jenkins, Mr. Albert R. Shattuck, Mr. John Quern, the Waterman Pen Company.

To further stimulate the prevention of accidents and the promotion of industrial hygiene, five Gold Medals are placed at the disposal of The American Museum of Safety for annual award. Three of these are in general fields. One, the E. H. Harrimon Memorial Medal, founded by Mrs. Harriman, will be competed for by American steam railways, for the best record in accident prevention and hygiene, affecting the public and its own personnel, during the current year. A fifth Medal known as the Rathenau Gold Medal of the Allgemeine Electricitaets-Gesellschaft of Berlin, is to be awarded for the best device or process in the electrical industries, safeguarding industrial life and health. This is one of the very few instances where the bestowal of a high European honor is made through an American institution.

The First International Exposition of Safety and Sanitation, held under the auspices of The American Museum of Safety in New York, last December, attracted an attendance of upwards of 113,000 people.

John R. Edwards, Rear Admiral, U. S. N., writes, January 2, 1914:

"Personally, I have no hesitation in stating, that it was the most instrutive and interesting Exposition I have ever attended, and I believe that it is but the forerunner of other Expositions conducted under the auspices of the Museum, that will do much for the safety and sanitation of the industrial work of this country".

The American Museum of Safety in the absence of any State or City endowment, has been able to carry on its work by private subscriptions and membership fees. These, however, are inadequate to the results which could be accomplished as evidenced by the work already done. Briefly recapitulating:

First—In co-operation with the Board of Education, through the Museum's own corps of Lecturers, 450,000 pupils in the public schools of Manhattan and Brooklyn have been reached by safety lectures, illustrated with models.

Second—The collections of The American Museum of Safety at the United Engineering Societies' Building, have been made the subject of special study by State and City Factory Inspectors; by pupils from the vocational, technical, high and other schools in the New York Public School System, normal school teachers, and special collegiate classes.

Third—Last year, a ten days' Exposition of Safety and Sanitation brought together safety appliances and methods for promoting health, whereby the entire citizenship of Greater New York could see practical inexepensive safety methods for safeguarding life and limb.

In connection with the Exposition, a three days' Conference was held on Safety and Health, at which national experts discussed the latest and most scientific methods and their application to these problems. These discussions were free to the public and were of great educational value.

A similar Exposition will be held in New York City, in December of this year.

Fourth—Loan collections from the Museum are sent, from time to time, to educational institutions. Frequent requests are received from educational institutions and organizations desiring to promote safety in other municipalities, but this co-operation is seldom possible on account of limited funds at Museum's command.

Fifth—Through its Research and Information Department, hundreds of questions are answered on definite, concrete problems of safety in mills, factories, and plants.

Sixth—The Museum's inspection service makes definite studies of industrial plants, following up these inspections with recommendations for the installation of safety appliances and the best hygienic methods.

Seventh—Lectures at the Museum reach special audiences, particularly safety inspectors and engineers, students and members of labor organizations.

Eighth—The Library contains a unique collection of reports, photographs, lantern slides and other specialized information on safety and health, to be obtained nowhere else, as evidenced by the statement of an investigator from the Public Library, that its collections were so complete that all questions and inquiries on these special subjects coming to the City Library, would be referred to the Museum.

Ninth—The members of the Museum's directors are serving on several important boards concerned with the safety and health of the municipality. They are also giving their time and efforts without any personal compensation whatever to the promotion of the Museum's work.

Tenth—The resources of the Museum could be placed at the disposal of every City Department for advice in the prevention of accidents and the promotion of health.

Eleventh—New York City is one of the most important factory centers in the world. Both City and State need the services of an institution which may be maintained as a clearing house of information on all matters of vital concern to the safety, health and working efficiency of the wage-earners of the Commonwealth. The Museum's aims and objects are heartily endorsed by the Central Federated Union of Greater New York, who ask that it be supported and maintained for the instruction and benefit of workers in every line of industry.

SAFETY FIRST IN THE SHOP LABORATORIES

B. W. BENEDICT
Formerly Safety Engineer for the Santa Fe Railroad
Director Shop Laboratories, University of Illinois

Under the provisions of an Act passed by the General Assembly of Illinois in 1909 aimed to promote the health, safety and comfort of employes, it becomes obligatory upon all owners of power driven machinery within the State to provide safeguards for the dangerous parts of same, and observe certain rules tending to insure the Safety of the workers employed. Previously, the protection of the worker was a question of policy with the em-

ployer and practice in respect to safe factory conditions varied in the same degree as the employers themselves and their ideals differed from each other. Safe and unsafe conditions existed side by side in adjoining factories. The act was rendered necessary by the failure of certain employers to take adequate measures for protecting their workers engaged in the operation of dangerous machinery. While the law did not materially affect those industries which had already given heed to the conservation of the lives and limbs of the workers within their walls, it compelled the indifferent producer to assume a more enlightened attitude toward matters affecting the workers and to make his plant a safer place to work in. The law was the natural expression of an enlightened Commonwealth seeking to protect those of its members engaged in occupations surrounded with more or less danger.

As the Safety Act is specific in respect to kinds of equipment to be safeguarded without qualification as to the purpose used for, it is clear that the machinery in the shop laboratories comes within the jurisdiction of the law. Although not used for commercial purposes this equipment has the same power to injure as any other and it should be protected as similar machinery used in industrial work. A sincere desire to remove unnecessary danger from the laboratories has always been a feature of University policy, but following passage of the Safety Act accident proof equipment was sought as before and also a strict compliance with all provisions of the law. Serious accidents in the laboratories fortunately have been few. The number in the last decade can be counted on the fingers of one hand, a truly remarkable record considering the large number of young men who during this time made almost daily use of the shop equipment. A record such as this is gratifying but not wholly satisfactory when he ideal is a clean accident sheet. Even with the most efficient safeguarding, accidents will happen if the workers fail to observe the ordinary rules of caution. Investigation shows that a large percentage of the accidents that happen result from recklessness and negligence on the part of individuals. This kind of accident may be classed as "unpreventable" because no form of safeguard can be devised that will absolutely prevent them. Practically all of the accidents that occur in the shop laboratories are of this type.

A spirit of carefulness on the part of the individual is just as essential as efficient safeguards in the prevention of accidents. In the shop laboratories both of these conditions have been sought. At the present time practically all of the machinery used by students is protected in a substantial manner and fully in accord with the law. Ultimately it is aimed to have every exposed part of running machinery whether directly dangerous or not, covered by a protecting guard. The hope is to make this machinery safe from every accident which might result from known or unknown causes. To anticipate the latter may appear altogether impracticable but the attempt is justified by the knowledge that prevention of an accident which otherwise might happen is the end to be sought. A remedy applied after the post mortem is just one accident too late. There is a large feeling of gratification in the fact that most of the safeguards have been designed, built and erected by the students themselves.

Carefulness is inborn in some while it seems to be almost totally non-eristent in others. The first needs no outside help to keep him away from dangerous practices, while the second lacking a certain coordination between mind and hands so necessary when using power driven machinery, must be protected against himself. Unfortunately we cannot fit out these individuals with a set of mental safeguards that work automatically and thus prevent these unjustifiable accidents, but we can by keeping ever before him the idea of "Safety First" minimize the number of disasters. Throughout the shop laboratories the words "Be Careful" in white letters on red backgrounds are much in evidence, also other cautionary signs on dangerous equipment. The object of these is to impress upon the mind (which may for the moment be wool gathering) the need for constant care. But few accidents occur when the mind is on the work and directing a safe course for hands and feet. These constant reminders exercise a positive force on the individual and experience here and elsewhere show they are effective instruments in the prevention of accidents. The safety first talks given at intervals are part of the plan to keep the senses alert to the dangers of carelessness. Illustrated lectures showing unsafe practices contrasted with safe and proper practices are being prepared and these it is hoped will stimulate more interest in the cause of personal safety.

First aid is given in case of injury by shop instructors who have taken special courses in first aid instruction and by virtue of this training are especially fitted to render this kind of service. The treatment given is usually adequate owing to the minor nature of the usual injury but it was planned as preliminary only to regular attention by a practicing physician. Detailed records of all vital information relative to accidents are being maintained in order to provide the means for a thorough study of accidents and their causes. It is hoped that a study of this kind will enable the staff to anticipate in some measure at least, those wayward excursions of the unthinking student into the fields of dangerous practices.

Grinding on emery wheels without goggles, using poor and dull tools, operating machines with guards removed, oiling or wiping machinery while in motion, unnecessary motions with tools which might injure nearby students, talking to others operating machines, are all forbidden practices which should not be indulged in. One of the most important rules of railroading "In case of doubt take the Safe side" should be the motto of every student taking work in the University laboratories. Safety guards will do much but even these do not fully protect the careless. They cut down the hazard without entirely eliminating the danger. The key to the situation is in the hands of the student himself—constant adherence to the slogan "Be Careful."

A YEAR'S RECORD IN ACCIDENT PREVENTION

MARCUS A. DOW

General Safety Agent, New York Central Lines

The problem of preventing accidents, or as it is more commonly called the "Safety First" problem, is beginning to attract the attention of persons in every walk of life. It is of interest to pause and reflect upon the development of this movement, which has become nation wide in scope, and ask the question as to what has been the cause of its phenomenal growth. The movement was destined from its beginning, I think, to be more than a passing fad or fancy, because the need of something of the kind in our industrial and public life was so apparent. An awakening American conscience pointed accusingly to a record of approximately 35,000 persons killed and two million injured in accidents in this country in a single year, and so to close the flood gates upon a surging sea of preventable accidents and educate the employer, the employe and the general public to work together to prevent the sacrifice of the lives and limbs of these persons who form the bone and sinew of our national existence, this great movement was started. The growth of the movement has been greatly enhanced by the gratifying results obtained, and the reason for the permanency with which the idea has become established is to be found in the far reaching benefits to humanity that have accrued since its inception.

Before speaking specifically of the results of Safety work on the New York Central Lines I think it will be of interest to state briefly some of the things that have made these results possible. Two important elements have received consideration in our accident prevention work,—one of these is the mechanical element, or the guarding of machinery, the installation of safety devices, or the correction of physical conditions, which, if left uncorrected, might contribute to unsafeness. The other is the human element, and realizing that the greater number of preventable accidents have been caused by unsafe practices, and the tendency of people generally in all walks of life to take chances, our old established policy of utilizing every reasonable mechanical safeguard, has been augmented by a thorough, systematic and persistent campaign of education, to educate both our own employes and the general public to avoid practices which involve risk of injury. As far as our employes are concerned, it has been our aim to bring about a co-operative effort on the part of all classes of employes that would curb this tendency to take chances. Railroad employes, not unlike persons in any other walk of life, become so accustomed to their surroundings that often practices, which involve risk of injury are followed unthinkingly. Most men would realize these practices were unsafe if their attention were called to them. Railroad officials, or the heads of industrial plants of any character, cannot observe the actions of all the employes, or any considerable part of them at all times, therefore, it becomes the important duty of every employe to call to the attention of his fellow employes, practices which involve risk of injury, when such practices are observed. In order to obtain results in the reduction of accidents, it is necessary for the men in the ranks to have the subject of Safety kept continually before them, and teach them that instead of waiting for an opportunity to perform a service that will prevent an accident, they must keep their eyes open and look for such an opportunity.

There have been many heroes in the ranks of railroad men, whose acts will live long in our memory as illustrations of heroism and strong devotion to duty, unexcelled even on historic fields of battle. Not long ago on one of our grade crossings, a flagman at the risk of his life rushed onto the track in front of a fast approaching train and seized a small boy who had run out in front of the train and jumped with the child in his arms clear of the train as it sped by, the pilot of the engine missing him by a fraction of an inch. That flagman's act deserves the highest commendation. He saw his duty, performed it unhesitatingly and today is a hero. But it is not always necessary to wait for the opportunity to perform some such spectacular act to save the life of a fellow being, for here is another incident. A section hand saw two workmen from an industrial plant located near the railroad, enter the right-of-way and start to take a short-cut across a bridge on which the track was laid. He stopped and warned them of their danger and told them thousands of human beings were killed every year because they took chances and walked the railroad tracks. Even while he was speaking to them a fast train rounded the curve and thundered by, and the trackman asked them if they realized what would have happened to them on that bridge if he had not stopped and warned them. The two men thanked him and one of them, who was a foreman, was so impressed that he went back to his mill and preached Safety to his men, warning them against the danger of trespassing on railroad tracks. This little incident was not recorded in headlines. That humble section hand was not hailed as a hero. But, nevertheless, he performed an act as commendable as that of any hero, for in giving that timely warning, which he considered it his duty to do, he not only probably saved the lives of the two men directly in danger, but prevented the other workmen in that mill from daily endangering their lives by trespassing on the railroad tracks. No one will ever know just what results in preventing accidents that obscure section hand accomplished by that simple performance of duty as he saw it, but it was a most commendable act, even though he did not have to risk his own life in the saving of another. There is not a railroad man or employe in any large industrial plant but what if he kept his eyes open, would soon have the opportunity to do a real service in the promotion of safety and perhaps save a life by giving a timely, friendly warning to a fellow employe whom he sees doing a thoughtless or impulsive thing that might result in an accident.

That is the kind of co-operation on the part of the working men that is necessary to make the Safety Momement a success. The mere slogan "Safety First" counts for nothing if these men are not educated to understand its full meaning and live up to the spirit of it. "Safety First",—they are simply two words which stand for a principle, and if the employes believe in that principle and believe that "Safety First" is a good thing for them and for their families—if they believe that life is sweet and that it is good to live and to live a comfortable life without being crippled or maimed—if they believe that it is better to be careful than crippled—if they believe it is better to correct unsafe practices and conditions than to make widows and orphans—if they believe in that—then they must make a firm decision way down deep in their hearts that they will support that principle not only by each one being careful himself, but by doing a constructive, co-operative and systematic work in bringing his co-workers to the support of that principle. Upon his fellow workers to a large degree depends his own Safety, and the thoughtfulness and self-control which guides the careful man in his work, must be inculcated by that man into the minds of those who work with him, to make the Safety Movement a complete success. And it is to instill that spirit of co-operation into the employes and recruit a vast army of Safety men, that our effort is being directed. We have endeavored to teach them that safe men are more important than Safety appliances. It is the neglect of little things that causes big accidents. As an illustration: the yard employe who thoughtlessly leaves a part of a coupler lying alongside the track may not consider his forgetfulness of any consequence. But suppose later on another man should alight from a moving car and stumble over that obstruction and fall sprawling under the wheels, and be dragged forth a useless, helpless cripple, to be for all his days, if he lives, a burden to himself and to society—a sight from which to turn the eyes—an unfortunate, pitiable thing, racked by pain and soured by the bitterness of his lot and all because some thoughtless fellow employe had left material where he knew it should not be, and did not *think* or *did not take the time* to remove it. Suppose that should happen, as it often has happened, would it still be a little matter and of no consequence? I think not. And so we are trying to impress upon our men the necessity of looking after these little things. That is the great lesson we have endeavored to teach, through our illustrated lectures conducted systematically in our lecture and Safety Exhibit cars, which we have even gone so far as to require our employes to attend on the Company's time; that is what we have taught through bulletins, pamphlets and a score of other agencies to keep this thought continually before the great army of men employed on this road.

But our efforts have not been confined entirely to educating the employe. Our work has been carried on in the broadest manner, and a systematic effort made to reduce accidents affecting the outside public, notably the trespasser.

Interstate Commerce Commission records indicate that there are more than 5000 persons killed and an equal number seriously injured each year while trespassing on railroads. The number of trespassers killed is equal to more than half of all fatal accidents occurring on railroads. Careful investigation shows conclusively that more than 75% of these trespassers who are killed are citizens of the wage earning class or women and children, only a small percentage of them being tramps or hoboes. Yet this forms one of the most difficult Safety problems we have to deal with. What we need is a uniform law in each state that will prohibit unauthorized persons from walking the tracks and make it a punishable offense. I will admit that such a law in itself alone will not prevent trespassing nor trespassing accidents any more than would a law which would require a person to stop, look and listen at a highway crossing prevent crossing accidents. Such preventive legislation must be reinforced by systematic, thorough and persistent education to convince all persons of the justice of such laws and that they were framed for their own protection and to save human lives and not for the mere purpose of guarding the railroad property against unlawful intrusion.

Public sentiment has demanded and received the safest and most improved equipment and methods of operation and, as a result, the number of passengers killed compared with the number carried is infinitesimally small. We should not forget that the man carrying his dinner pail on his arm who takes a short cut along the tracks is just as dear to his family and of just as great value to the community as though he paid a dollar to ride. If the public will take enough interest in the individual acts of the trespassers and the travellers on the highway to insist upon the elimination of their recklessness, a great step will be taken towards the solution of the problem of preventing this class of accidents, which, after all, is the public's problem and needs only the public's attention to prevent.

New York State is in advance of most states in that it has an adequate law prohibiting unauthorized persons from walking the tracks. In our educational campaign we have employed a Safety Agent to devote his entire time to this trespass problem. He has called upon the judges of all courts in this state having jurisdiction and sought their co-operation in the enforcement of the law for humanity's sake; he has called upon and received the prompt support of the editors of newspapers in giving a wide publicity to our campaign; he has posted notices in various languages along the entire right-of-way calling attention to the dangers of trespassing; he has called upon the heads of manufacturing plants located along the road and the Superintendents of Schools to solicit their aid in the education of both children and adults, and because we have done all of these things in a systematic and persistent manner, thereby educating the public against the dangers of trespassing, there were on the four principal roads of the New York Central Lines during the year ending June 30th, 1914, as compared with the previous fiscal year, 109 fewer trespassers killed and 83 fewer trespassers injured. And as a result of all of this educational work both as to employes and the public, there were on these same roads of the New York Central Lines during the twelve months ending Sept. 30th, 1914, as compared with the previous twelve months, 330 fewer persons killed and 4074 fewer persons injured in all classes, including employes, trespassers and others. On the New York Central proper, east of Buffalo, during the year ending June 30, 1914, as compared with the previous fiscal year, there were 102 fewer persons, all classes, killed, which is equivalent to 102 human lives saved, due in a great measure to effective Safety education.

In order to further stimulate this work and make the lessons more impressive, we have introduced a new feature in our Safety educational work by producing a moving picture play for the purpose of educating the employes to be careful. I have prepared a two reel film entitled "Steve Hill's Awakening", with a view not only of arousing interest, but of making a lasting impression on the minds of the employes and their families who witness it. Didactic lectures, stereopticon views, bulletins, etc. have their uses, but it was my thought that if railroad men could see pictured in active form some of the things they do that cause injury, and incidentally tell a human interest story that would drive home the far reaching and unhappy consequences of negligence, it would serve better than anything else to curb the chance-taking habit among them. While this is the first attempt of any railroad to use a moving picture story of human interest, with the principal parts played by professional actors and actresses, to teach safety, I feel sure it is only the beginning of an extensive use of moving pictures for this purpose.

It has been our idea that whatever work was attempted along Safety lines, must be constructive in character and aim to a definite purpose. You cannot start out with a great "Hurrah Boys" and shout the slogan "Safety First" and let it go at that and expect results. Whatever work in the way of Safety education is attempted, whether public or industrial, must be constructive in character and aim to a definite purpose and work must be conducted along clearly defined lines, pointing out what is unsafe, what causes accidents and what must or must not be done to prevent them. Such education beginning with the children in the schools and carried on in all industries and in all railroads will in the end produce humanitarian results that will be the greatest monument to our civilization that was ever erected.

SAFETY FIRST

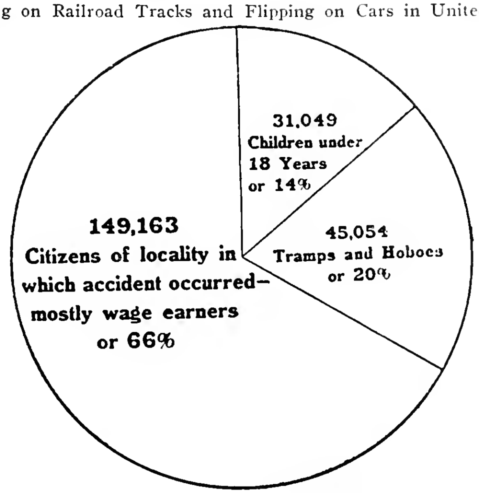
RALPH C. RICHARDS
Chairman, Central Safety Committee, Chicago & Northwestern Railway

Prior to the inauguration of the Safety First movement, there had been for ten or fifteen years, much discussion in the public press, among the people, in the legislatures and in Congress on the question of prevention of accidents by law; and, in pursuance to the theory that the fixing of greater liability on the employer to respond in damages would make them more careful and thereby reduce the number of accidents, employers' liability laws, laws

Diagram No. 1 will show the importance of stopping people trespassing on the tracks and cars.

DURING THE LAST TWENTY-FOUR YEARS
108,009 PERSONS KILLED
117,257 " INJURED
225,266

Walking on Railroad Tracks and Flipping on Cars in United States



Why not make and enforce Laws to prevent this Slaughter?

taking away the defense of fellow servant, assumption of risk, contributory negligence, as well as workmen's compensation laws, were enacted, with the result of requiring the employer to respond in damages for the benefit of the injured man or his dependents, but without any result worth mentioning in the way of reducing the accidents or decreasing the toll of death and injury, which is what the workingman, the employer and the public most want and need.

As no reduction in the number of accidents was accompanied by such laws, some other method had to be adopted, as neither the workingman, the employer, nor the public could longer stand any such drain of human life, which, according to the government reports, amounted to one death every sixteen minutes, or 98 each day of every one of the 365 days in the year, and four injuries every minute of every hour of every day, or 5720 each day of every one of the 360 days in the year. And contrary to the general understanding only one tenth of the deaths and one sixteenth of the injuries to the workmen were on the railroads; the others occurring in factories, shops, mines, stores and on farms.

If I were only a word painter or an orator, as a man ought to be who has such a subject as this to talk about, so that I could visualize to you, to every workingman and his family, to every employer and to the public what these statistics of 35,000 workingmen killed and 2,000,000 injured every year means, of the suffering and privation and often destitution, the loss of efficiency in carrying on our industries, as well as the loss to the community that follows in the wake of these 35,000 funerals and the vast army of cripples and injured people, then I could secure your active help in the greatest movement now in existence in this country—the movement for the CONSERVATION OF HUMAN LIFE.

The management of the Chicago & North Western Railway recognized perhaps earlier than most other employers of labor, the great suffering caused by avoidable accidents resulting in death and injury to its men, passengers and others. It was determined about four years ago to inaugurate a movement to reduce such accidents, both as a matter of humanity and for the purpose of increasing the efficiency of the organization. We recognized that every time a capable, experienced employe was killed or injured it not only brought suffering and sorrow to himself and family, but necessitated the employing of a new and inexperienced man in his place, thereby increasing the risk to the other men in the service and at the same time decreasing the efficiency of the organization, frequently very seriously.

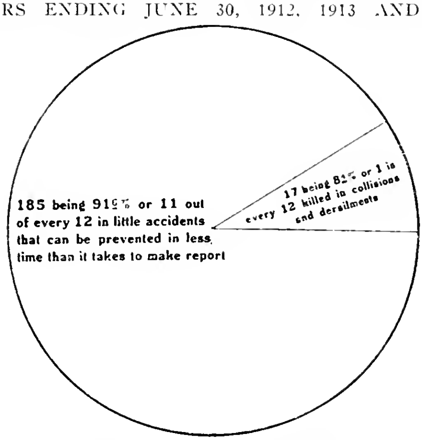
The work of organizing and directing this movement was assigned to me and as I believed that only through the active co-operation and assistance of the men who were being injured and killed could any plan for the prevention of accidents be made a success, and that if the men could be gotten to understand the matter right, their co-operation and assistance could be secured, I undertook to organize the movement on the basis of making the men the controlling factor in the movement.

For all practical purposes the only accidents that can now be materially reduced on the railways without the assistance of the public are those resulting in death and injury to employes, and during the past four years great efforts have been made to do something in that direction and I am glad to say that by the

Diagrams Nos. 2 and 3 show the importance of preventing little accidents.

No. 2

EMPLOYES KILLED ON
THE CHICAGO AND NORTH WESTERN RAILWAY,
YEARS ENDING JUNE 30, 1912, 1913 AND 1914



Stop the little accidents and we will
wipe out the accident business

enthusiastic co-operation of the men and the managements the effort has been successful. The movement bringing about that result is now generally known as SAFETY FIRST and it stands for:

The conservation of human life.

The making of Safety men as well as Safety things.

The elimination of the Chance-taker, who is the maker of cripples, widows and orphans, and

For greater Safety and Regularity.

The church tells us that the saving of souls is the most important work in the world; always has been and always will be, and yet some people sell their souls for money, reputation, glory or to satisfy ambition, love or hate. But no one will sel his life or limb; it is our most precious possession; the one thing none of us will part with, and so it seems to me that CONSERVATION OF THAT LIFE AND LIMB must be the second most important work in the world, a million times more important than the conservation of our water power, land, timber, minerals, coal or anything else.

In May, 1910, we commenced the work by holding meetings on all the divisions of the system, first of the division officers and foremen, and afterward of the men, and explained what we intended to do and its necessity.

That it was the men and not the stockholders, officers or foremen who were killed and injured and paying the fearful toll in death and injury.

That it was the men and their families who would be most benefited by the prevention of accidents.

That the golden rule in railroading—"IT IS BETTER TO CAUSE A DELAY THAN TO CAUSE AN ACCIDENT"—should be observed.

That it actually took less time to prevent an accident than it did to report one.

That when we needed new men, if we had fewer accidents on our road than other lines had, we would have the pick of all the best railroad men in the country.

That we wanted to get rid of the careless habit and acquire the Safety habit.

That we wanted to stop making cripples, widows and orphans.

That the greatest risk a careful man runs is the risk of injury from some careless fellow-worker, and that when the careless man will not change his ways and try to do better, he should be gotten out of the service.

That EVERY ACCIDENT is a notice that something is wrong with the man, plant or methods and should be immediately investigated by persons in charge of the work to ascertain the cause and to apply a remedy.

That if we would reduce the accidents 50 percent the assessments for life and accident insurance which the men are paying ought to be reduced in the same proportion.

Division Safety Committees were then organized in each division of the road, composed of the Superintendent, Division Engineer and Division Master Mechanic, and one or more representatives from each class of labor, such as engineers, firemen, conductors, brakemen, switchmen, signal men, trackmen, station men, bridgemen, carmen, telegraph operators, train dispatchers and linemen.

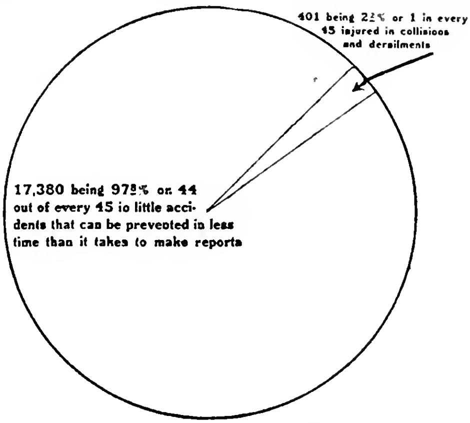
Terminal Safety Committees were organized in the large terminal yards, the members being yardmasters, switchmen, engineers, firemen, trackmen and carmen.

Shop Safety Committees were also organized, composed of all classes of labor employed in the shops—always the men who were doing the work and getting hurt (not the bosses), being the large majority of the membership.

Local Safety Committees composed of a representative of each class of labor employed in that vicinity were also organized at outlying points, in order to stimulate the interest in the Safety movement.

No. 3

THE CHICAGO AND NORTH WESTERN RAILWAY,
YEARS ENDING JUNE 30, 1912, 1913 AND 1914



Stop the little accidents and we will
wipe out the accident business

These committees meet once each month. The men serve not less than six months nor more than twelve, and are paid for their time and expenses while attending meetings.

Then the Central Safety Committee was organized, composed of eleven general and division officers, representing all branches of the service, of which I am the chairman, and to whom all division, shop, terminal and local committees report and to whom all changes in standards, rules and customs are submitted, and, if approved, are referred to the management for adoption. All matters local to the divisions, shops and terminals are disposed of by such committees without reference to the Central Safety Committee.

On a railroad 8,408 miles long, running through nine states, it necessarily took some time and considerable work to lay the foundation for such an organization and get it properly started, but on January 1, 1911, our organization was practically completed.

During the year 1911, being the first year this organization was in existence, 5,619 different subjects were brought to the attention of these committees and acted upon.

During the years 1912 and 1913, 10,159 suggestions were made by these committees, of which 9,772 were adopted.

In 1911, 1912 and 1913 two hundred and seventy-six recommendations made by the various Division, Shop, Terminal and Local Safety Committees, changing standards, rules, methods or conditions were approved by the Central Safety Committee and adopted and put into effect by the management of the company.

Every member of the committees is furnished with a Safety button as his badge of office and is made to feel that in the meetings all are on a par, and that each man comes there as a committeeman, not as an officer or employe, and that all are full partners in the enterprise and responsible for its success.

That suggestions that might bring about greater safety and efficiency in operation were not only invited but solicited. Postal cards were furnished to the members of the committees and employes generally, on which immediate notice could be given to the chairmen of committees of dangerous conditions and practices, so that the same could be remedied immediately and not wait for the meeting of the committee.

Meetings were also held at various points on the system at which the general public were invited for the purpose of interesting them in the safety movement. At such meetings talks were given on the subject, illustrated by lantern slides.

This company has also prepared and sent to all the school and municipal authorities along its lines what is known as a trespass circular, fully illustrated, calling attention to the great number of men, women and children killed and injured trespassing on the railroad tracks of the country, in hopes that the school authorities, after having their attention called to the matter, would instruct the children and so prevent some of these unnecessary accidents occurring.

During the year 1913—which is the last year for which accidental statistics have been furnished by the Interstate Commerce Commission—5,558 persons were killed and 6,310 were injured walking on the railroad tracks or flipping on the cars. Fifteen times as many trespassers were killed as passengers, and twenty-eight times as many as passengers killed in train accidents, fourteen every day in the year, because we either have no laws penalizing trespassing on the tracks and cars or if we do have, neglect to enforce them. I think it a conservative statement to say that it would cost the states, counties and municipalities less to enact and enforce trespass laws than it does to pick up and bury the dead, hold inquests on the bodies and care for the crippled.

During the last twenty-four years there were

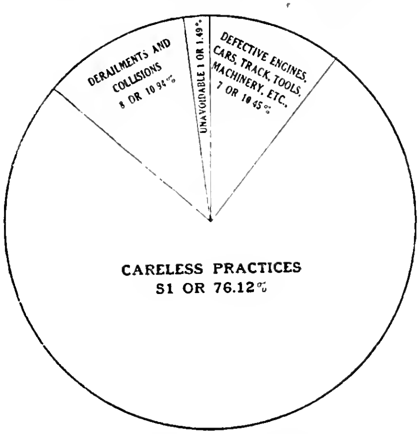
108,009 persons killed,
117,257 persons injured,

225,266

walking on railroad tracks and flipping on cars in the United States.

Diagrams Nos. 4 and 5 show the importance of stopping the careless practices.

THIS DIAGRAM SHOWS THE CAUSES OF ACCIDENTS IN WHICH EMPLOYES WERE KILLED WHILE ON DUTY DURING THE YEAR ENDING DECEMBER 31, 1913



Why not stop careless practices and so reduce injuries and deaths to North Western men?

149,163 were citizens of the locality in which the accident occurred, mostly wage earners—or 66%
31,049 were children under 18 years—or 14%
45,054 were tramps and hoboes—or 20%

After the work was well under way it was decided to award a banner to the division having the fewest accidents in proportion to the number of employes and its train mileage, and the Central Safety Committee awarded that banner to the Sioux City Division for 1910, the Wisconsin Division for 1911 and 1913, and the East Iowa Division for 1912.

We believe that this is the first time that such an award has been made in the history of railroading in this or any other country.

Safety rules for employes engaged in the shops and on the tracks were prepared by the Central Safety Committee, printed in many languages and furnished to every employe in these departments.

There are now about 913 officers and men serving on these committees and if Benjamin Franklin's saying that the eyes of the master can do more work than both his hands is true, surely 913 pairs of eyes, trained to look for defective conditions and dangerous practices, can do more than the eyes of one officer or fifty officers, and from the results that have been attained during the fifty-three months that the safety organization has been in existence (during which time the earnings and mileage of the company have increased) we have shown a very gratifying improvement in the matter of:

- Cleaning up obstructions in yards, station platforms, shops and roundhouses;
- Installing additional light to secure better working conditions;
- Putting up railings at dangerous places;
- Covering gearing, belts and moving parts of machines;
- Blocking frogs and guard rails;
- In putting a stop to dangerous practices and customs;
- Better inspection and repair of cars, engines and machines, which has not only brought about greater safety, but also more efficient operation.

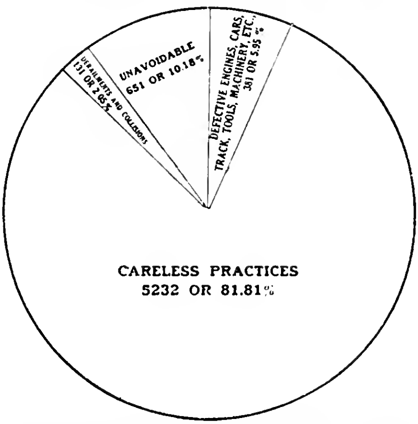
We also show the following reduction in our accident record, as compared with fifty-three months on the basis of the year ending June 30th, 1910, that being the last year prior to the organization of the safety committees. In these statistics every accident is counted where the injured person loses more than one day's time:

165 fewer employes killer, a decrease of 34.4%
10174 fewer employes injured, a decrease of 26.6%
878 fewer passengers injured, a decrease of 21.5%
206 fewer outsiders killed, a decrease of 19.4%
206 fewer outsiders injured, a decrease of 7.6%

This not only means that in the last fifty-three months we have had 369 fewer reports of people killed and 11,258 fewer reports of people injured than we would have had during that period on the basis of the year ending June 30, 1910; but that 369 fewer times did we have to call the priest and the undertaker; that 369 fewer times were widows and orphans made and sorrow and sometimes destitution brought into families; that 11,258 fewer times was someone injured, often permanently; that just that many times fewer did we have to call the doctor, and that in our own railroad family, 11,258 times did we avoid increasing the risk of other employes, our passengers and patrons by taking experienced men out of the service and putting green ones in their places, and that just that many fewer times did we avoid decreasing the efficiency of our organization.

This result has been obtained because we have learned that accidents are not inevitable, as we had commenced to believe, but, on the contrary, a large proportion of them can be avoided by the exercise of care.

THIS DIAGRAM SHOWS THE CAUSES OF ACCIDENTS in WHICH EMPLOYES WERE INJURED WHILE ON DUTY DURING THE YEAR ENDING DECEMBER 31, 1913



Why not stop careless practices and so reduce injuries and deaths to North Western men?

And because the North Western men demonstrated that Safety First stands for

The conservation of human life,
Greater safety and regularity,
Safety men as well as things,
Increased efficiency, and
Greater harmony and co-operation,

seventy-six other railroads, with a mileage of over 197,505 miles, have also adopted the North Western Safety First organization, or one practically similar to it.

Every year about 1500 North Western men serve on these safety committees and become more or less imbued with the idea that Safety must be *FIRST*. Eventually we hope to have every permanent employe of the North Western Railway serve as a

Safety Committeeman. We believe that this must certainly result in gradually bringing about a higher regard for life and limb and for greater safety and regularity in operation.

Once or twice each year the Chairman of the Central Safety Committee and as many of the members of that Committee as possible visit each Division, Shop and Terminal Committee, spend a day or more with them, attend their meetings, take part in the transaction of the business of the Committee and do everything possible to keep up the interest and enthusiasm of the men.

In this connection we desire to call attention to what the Interstate Commerce Commission say in their 1912 report:

> "Great possibilities in the direction of a solution of the problem of accident prevention lie in the so-called Safety Committees which have been organized on many roads. These committees are composed of officers and employes who co-operate in striving to eliminate accidents due to failure of men properly to perform their duties. By making "SAFETY FIRST" the dominant idea in the minds of employes and continually pointing out methods for its attainment, an important step in the right direction is taken."

Safety First is not a question of dollars and cents; it is a question of saving human life, the most valuable thing in the world which, when once gone, can never be brought back. It is trying to save men from losing their legs and their arms which never can be put back, it is trying to save the making of widows and orphans, destitution and misery. Neither the officers nor the laws can do it. But whether the men themselves can do it or not I believe is best indicated by the following statement showing what has been accomplished by the Safety First Committees during the five months ending November 30th, 1914, as compared with the same months in 1913 and 1909, the latter being the last year before the organization of the Safety First Committees:

	1914	1913	1909
Employes injured	2587	2963	3602
Employes killed	22	32	51

This means a reduction in injury cases in 1914 as compared to 1913 of 12.9% and compared to 1909, a reduction of 28.4%; it means a reduction in fatal cases in 1914 as compared to 1913, of 31.3% and compared to 1909, a reduction of 58.8%.

If we had some way of inoculating men with safety virus or of quarantining the careless men the same as we do scarlet fever, smallpox or diphtheria patients, we would very soon stop the accidents.

PROGRESS OF SAFETY WORK AT THE NORTON COMPANY

Norton Company Inspection Department

History

Organized safety work at the Norton Company had its beginning in March, 1909, when a Safety Committee of five members was appointed, and given instructions to make an inspection of the Plant, and to make recommendations with a view toward

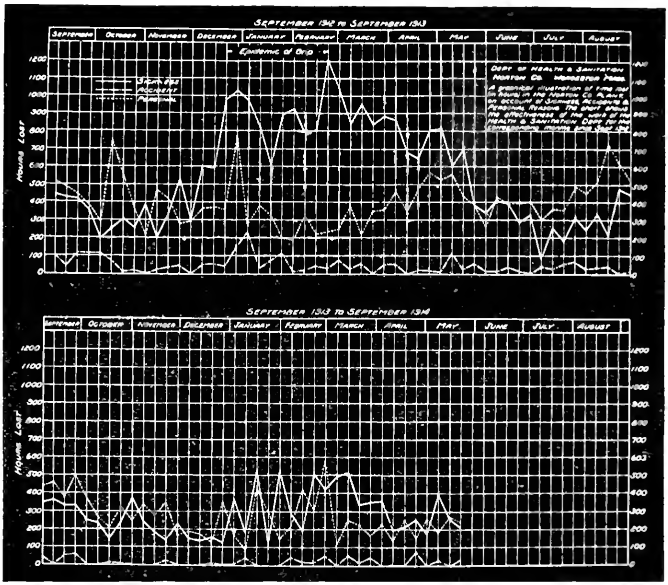


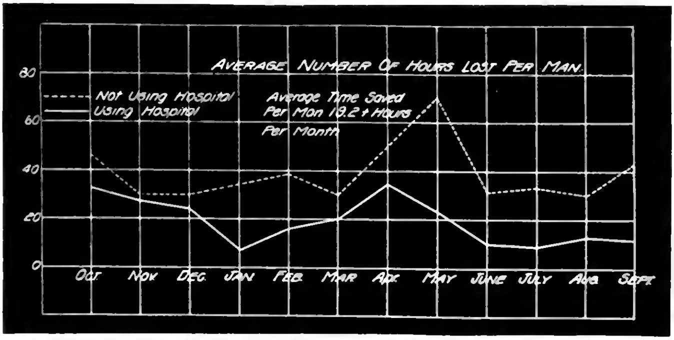
Chart Showing Time Lost Comparing Years 1913 and 1914

reducing to a minimum the danger of accidents to the workmen.

This Committee, which was made up of four heads of departments, and one member of the Engineering Department, is still in existence and since its organization has made monthly inspections of the Plant and held monthly meetings, the principal result of their work being the installation of nearly every practical mechanical safeguard possible. At first, only the most dangerous places were protected, but by degrees, all the lesser dangerous were also guarded against until at present it is very seldom that the cause of an accident can be traced to the lack of a mechanical safeguard.

In the fall of 1913, the so-called "Safety First" movement was being very much agitated all over the country. The most important thing which was being pointed out was the fact that the education of the workmen in matters pertaining to safety was fully as important as the installation of mechanical safeguards. Although the number of accidents in the Norton Works had already been materially reduced by the installation of such mechanical guards, it was decided to conduct a safety educational campaign, in order to reduce still further, if possible, the possibility of accidents.

Deliberate plans were accordingly made for such a campaign and later put into execution. The principle of this campaign was



Comparison of Time Lost by Men Who Came to the Hospital and Those Who Did Not, During the First Year

to keep the "Safety First" idea before the men at all times, and as a means towards this end, a Safety First Association was organized in March, 1914. Any employee who could memorize a set of twenty "Safety First" rules was made a member and was given an attractive membership button. The charter list consisted of one hundred and forty names, including executives of the Company, foremen and others. The membership now numbers five hundred. Occasionally social evenings are held for the members, and a series of instructive lectures has been planned for the coming winter by the Social Committee of this Association.

To further stimulate the interest of the men in the "Safety First" movement, a system was adopted of appointing a Safety Inspector in each department. These inspectors are chosen from among the workmen and each serves for a period of three months. Their duties consist of assisting in the enforcement of the "Safety Rules" and of making safety recommendations. Each of these inspectors wears a distinctive badge during his term of service.

The workmen in addition to being cautioned against carelessness are encouraged to make safety suggestions and a special form has been printed for this purpose. We have received many valuable suggestions from this source.

FIRST AID

IN CASES OF

ILLNESS OR ACCIDENT

Instructions to Dressers

First Duties

1. Notify Doctor, i. e., W. Irving Clark, M. D., 37 Pearl St., Telephone Number 604-2.

   or

   Philip H. Cook, M. D., 771 Main St., Telephone number 2168-5.
2. Telephone for Ambulance, if necessary, Number 7140.
3. Prepare bowl of hot water, soap, scrubbing brush and gauze for cases of cuts and bruises.
4. Prepare splints in cases of severe injuries.
5. When patient arrives, proceed at once following directions given by Doctor for that type of injury.

For Burns and Scalds

1. Remove all clothing from injured part.
2. Immerse extremity in large pail or foot tub containing Sat. Sol. Bicarbonate of Soda.
3. Parts which cannot be immersed should be covered with soft cotton cloth soaked in carron oil.
4. Slight burns should be powdered with Compound Stearate of Zinc Powder.
5. If much shock, give one teaspoonful Aromatic Spts. of Ammonia in one-half glass of water; or, one tablespoonful of Brandy in one-half glass of water.
6. Give 1/4 grain Morphine by mouth if pain unbearable.

For Fainting and Sudden Sickness

1. Get patient on back with head lower than heels.
2. Give one teaspoonful Aromatic Spts. of Ammonia in one-half glass of water.
3. Towel in cold water to head.

For Fractures and Dislocations

1. Remove clothes about part by cutting.
2. Put part at rest on splint after applying a dressing of gauze soaked (dripping wet) in Lead and Opium mixture.
3. Let patient lie down.
4. If pain very severe give Morphine grain 1/4.

For Major Injuries

Fractures with Laceration, etc.

1. Remove clothes around injury by cutting.
2. Wrap all exposed parts EXCEPT INJURY in blanket.
3. Put patient on his back.
4. Cover with blanket.
5. Wash around wound thoroughly with soap and water as in minor injuries.
6. Put on large pad of gauze soaked in Bichloride of Hg. 1-1000.
7. If patient pale and white, one teaspoonful Aromatic Spts. of Ammonia in one-half glass of water.
8. If much pain, morphine grain 1/6, by mouth.

For Minor Injuries

Crushing or cutting injuries involving fingers, hand, foot or small areas.

1. Clean thoroughly by washing part in hot water with green soap using scrubbing brush for area around the wound and gauze for wound itself. DO THIS FIVE MINUTES BY WATCH.
2. Wash off in Turpentine or Benzine (NOT IMMERSING).
3. Soak in Bichloride of Hg. 1-1000 sol. for THREE MINUTES BY WATCH or until Doctor arrives. If Doctor is not required apply sterile gauze bandage and finger splint.

DO NOT TRY TO STOP FLOW OF BLOOD UNLESS VERY SEVERE. THE HOT BICHLORIDE SOAK AND BANDAGE WILL DO IT.

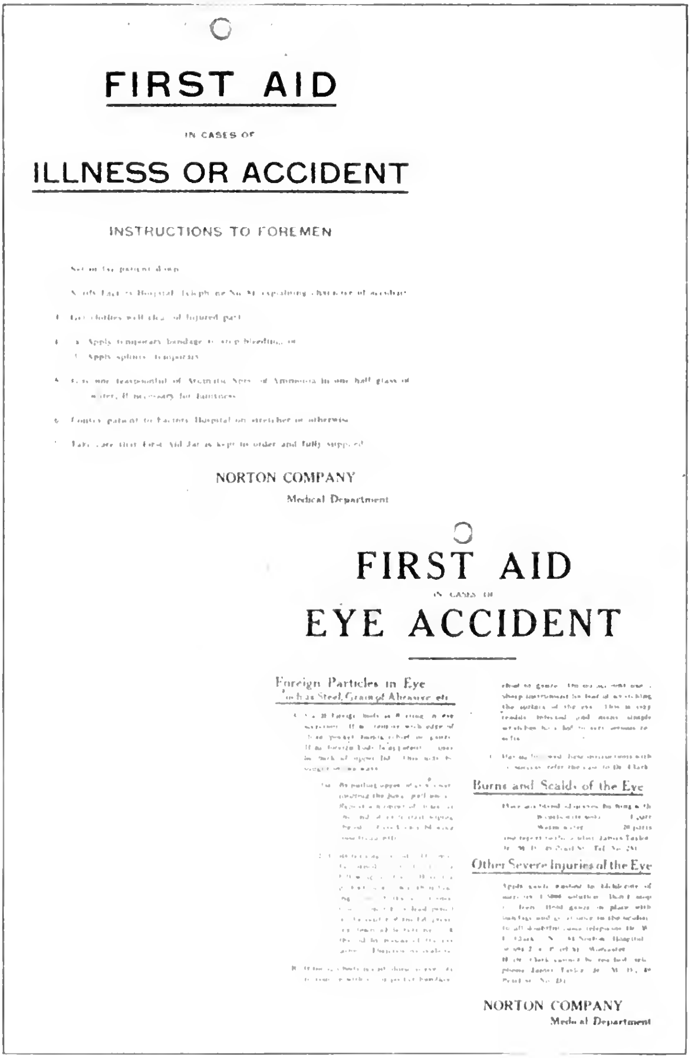
NORTON COMPANY

Medical Department

A book of standard safety specifications for use in our Plant has been issued in order that all might know just what was meant by safety. Several other booklets have also been issued on the subject of safety in general.

Present Activities

The Safety Committee makes monthly inspections and holds monthly meetings.


FIRST AID

IN CASES OF

ILLNESS OR ACCIDENT

INSTRUCTIONS TO FOREMEN

NORTON COMPANY
Medical Department

FIRST AID

IN CASES OF

EYE ACCIDENT

Foreign Particles in Eye

Burns and Scalds of the Eye

Other Severe Injuries of the Eye

NORTON COMPANY
Medical Department

The Safety First Association conducts lectures and holds social evenings.

Department Inspectors appointed every three months and at expiration of service are written personal letters by the Works Manager.

Workmen in general make safety recommendations on special form provided.

Interest kept alive by posting of bulletins throughout the Works and by live articles published in the shop newspaper and other publications. These articles include lists of names of men who have made safety recommendations, new members of the Association, etc.

Results

Practically all dangerous parts of machines have been well guarded, many special and unique safety devices having been installed to meet special conditions.

Where it has been found impossible to install satisfactory guards, conspicuous warning signs have been posted and special instructions issued.

Standards for such guards and signs have been adopted and all future installations will be properly protected.

Previous to the time when this safety work was started and for a considerable time thereafter, it was not possible to keep an accurate record of the accidents which occurred, owing to the fact that the men were accustomed to report only the more serious accidents. At present, even the slightest accidents are reported. This condition makes it very difficult to secure any data which will show the true reduction in accidents which must be due to this safety work. The following figures are very interesting, however. During a period of seven months, ending November 1, 1913, there was an average of one accident causing actual loss of time for every twenty-nine employees. During the corresponding seven months of 1914, there was an average of one such accident for every sixty employees. It is, of course, impossible to state just what was the cause of this reduction, but we believe that our "Safety First" work was the principal reason.

The following two incidents will also help to show how the "Safety First" habit has been acquired by both foremen and men.

One of our foremen was at first very much opposed to the installation of any guards on any machines in his department, thinking the "Safety First" idea was all nonsense. A few weeks ago a spare machine was set up in his department, and as we did not contemplate using it for a few weeks, the installation of the usual guards was postponed for a few days on account of rush of other work. It happened that this foreman had occasion to start this machine before the guards were in place, but before doing so he called the Secretary of the Safety Committee to his department and fairly "raked him over the coals" for not having the usual guards in place. It was also very interesting to see all the precautions he had taken to put up temporary guards before starting the machine. And this was the same foreman who a few months ago thought safeguards were a nuisance.

About two months ago one of the workmen met the Secretary of the Safety First Association and without any solicitation gave the following "testimony." He said in substance "Your 'Safety First' idea is taking hold of me all right. Yesterday, while walking through the shop, I met two men rolling a heavy iron mould and my first impulse was to run across in front of it, but I thought of 'Safety First' and waited until they had passed."

The Norton Company publishes a number of interesting bulletins and booklets on the Safety First work at their company, among which are the following:

Safety as Applied to the Use of Grinding Wheels
Health and Sanitation
Safety as Applied to Grinding Wheels
Report on Investigation of Grinding Wheel Protection Devices
Standard Safety Specifications
What to do in Case of Fire
Health and Safety Bulletins (In book form)
Safety Rules
Safeguarding Grinding Wheels.

EDITOR.

EFFICIENCY IN ACCIDENT PREVENTION

ROBERT J. YOUNG
Manager of Department of Safety and Relief, Illinois Steel Company

It is clear to a student of the subject that in order to procure efficiency in accident prevention, three broad branches of this work must be undertaken, viz.: Organization, Safe Guarding and Education. Full efficiency cannot be obtained if one of the branches is neglected.

The question frequently is asked as to the relative value of the different branches of this work, and although it is difficult to separate them, careful observation leads to the following conclusions:

Organization	60%	
Education	25%	
Safe Guarding	15%	100%

Or, going more into detail, they would be divided about as follows:

Organization—		
Attitude of Officers	30%	
Safety Committees	20%	
Inspections (Workmen)	10%	60%
Education—		
Instruction of Men	9%	
Prizes	8%	
Posting Signs	2%	
Lectures	6%	25%
Safe Guarding—		
Guards	8%	
Lighting	3%	
Cleanliness	4%	15%
		100%

SAFETY ORGANIZATION

As an example, let me describe the Safety Organization of the United States Steel Corporation and the Illinois Steel Company, a subsidiary company of that Corporation.

For a number of years the United States Steel Corporation and its subsidiary companies have been carrying on an active campaign for accident prevention.

Covering the entire United States Steel Corporation, with refernce to this subject, is a Committee of Safety composed of the

General Solicitor of the Corporation, Raynal C. Bolling, who acts as chairman; C. L. Close, Manager of the Bureau of Safety, Sanitation and Welfare of the Corporation, who acts as secretary, and seven members, each being a representative of one or more of the subsidiary companies, and engaged in safety work.

This committee conducts thorough inspections of all plants of the subsidiary companies from the standpoint of safety. At its quarterly meetings the committee considers proposed safety devices and plans for interesting the workmen, and acts as a clearing house, disseminating this information to all companies. It also considers all serious accidents which have occurred in any of the companies with the view to preventing their recurrence.

The Committee has compiled a book of rules governing the installation of machinery, and issues periodically bulletins on Safety, Sanitation and Welfare work.

Before describing the safety organization of the Illinois Steel Company, I should state that this organization is typical of the safety organizations of all of the subsidiary companies. A Central Committee of Safety has general jurisdiction in safety matters over the five plants of the company. This committee is composed of the General Attorney of the company, who acts as chairman, his assistant in the Law Department in accident matters, the Assistant General Superintendent and the Safety Inspector of each of the plants and the Manager of the Safety and Relief Department, who acts as secretary.

A meeting of the Committee is held once a month, and at these meetings all accidents occurring at the several works which are in any wise serious or from which a lesson can be drawn are considered, and, if possible, steps taken to prevent a recurrence. This Committee also considers safety devices and schemes to interest the workmen in accident prevention. These subjects may originate in the Committee or be referred to it by plant committees of safety, or from other subsidiary companies' safety committees through the committee of safety of the Corporation.

To assist this committee, from time to time, a meeting of a sub-safety committee composed of engineers, or master mechanics, or department superintendents, is called to consider special questions that have arisen and on which the members of the Sub-Committee are experts.

The Committee has issued books of rules and specifications, standardizing safety devices and regulating operations from a safety standpoint. Safety bulletins, profusely illustrated with pictures showing how accidents happen and how they may be prevented, pictures of safety devices invented by workmen, together, if possible, with a photograph of the inventor, accident charts, etc., are published monthly.

Each plant of the company has a safety committee composed of the Assistant General Superintendent, who acts as chairman, the Safety Inspector, who acts as secretary, and two or more department superintendents. The committee has general jurisdiction over safety matters in that plant, and meets once a month, the regular meeting being at least one week prior to the meeting of the Central Committee of Safety. At these meetings all recommendations from any source are considered and a careful record kept as to the progress of work upon the recommendations made for the different departments.

In checking the accident records of the different departments, this committee also considers the number of cases of discipline reported from that department, as it is firmly believed that enforcement of the rules has a direct bearing on the number of accidents. When a serious accident occurs in the plant, the committee goes in a body to the scene of the accident and makes a thorough investigation. There is no question but that these investigations by officials have a tendency to impress all with their sincerity in the work of accident prevention, but it also insures careful considerations, by those empowered to act, of the conditions causing an accident. All accidents occurring at their own or other plants are made a subject for special discussion by this committee, and, if possible, recommendations made for their prevention. Complete records of the meetings of the Plant Committee of Safety are sent to the Central Committee of Safety, with a copy to all other plants.

In each department of a plant is a committee of safety composed of foremen and workmen. It is the duty of this committee to make monthly inspections of their department in a body, recommending Safety devices, and plans for preventing accidents, by eliminating dangerous practices or suggesting schemes to advertise the necessity of all workmen being watchful at all times for their own and others' safety. Their report goes to the superintendent, with a copy to the secretary of the Plant Committee of Safety, and is by him presented at the regular meeting of that committee, together with a report as to what action has been taken thereon.

The department committee also makes an immediate investigation of all accidents occurring in the department which will cause the loss of more than ten days' time or from which a lesson may be drawn, reporting to their superintendent, with a copy to the secretary of the plant committee of safety, how the accident happened; what, in their opinion, can be done to prevent a similar accident; who, if any one, they think was negligent, and what discipline they recommend being meted out to the negligent person.

It will be seen from the above that reaching from the smallest department in a plant to the Committee of Safety of the United States Steel Corporation there is a closely knit organization, co-operating in accident prevention. Safety propositions originating in a safety committee of a subsidiary company are passed through the Committee of Safety of the Corporation to the Central Committee of Safety of other subsidiaries, and by that Committee on to the Plant Committees and the Department Committees. When advice is wanted on how to prevent a certain kind of accident and a call is sent out from anywhere along the line, it is sure to reach both ends of the organization of safety committees, in all companies, which means that thousands of minds are giving the subject their best thought, and if any means of betterment can be found, they will be found.

SAFE GUARDING DANGEROUS PLACES

It would not be practicable to attempt to cover the details of safe guards in this paper, but possibly a description of a systematic method of insuring the installation of proper guards would not be amiss.

The Central Committee of Safety of the Illinois Steel Company has for some time been engaged in standardization work. A book of plans for devices of safety has been prepared for the purpose of standardizing the safety appliances and precautions necessary to protect employees from the dangers incident to machinery and unsafe working conditions and to secure the provision of efficient safe guards and proper working conditions at the time construction work is planned and machinery is installed, as well as to show the conditions to be maintained during operation. This book has been prepared in loose leaf form so that additions or amendments may be readily made to it. The plates in this book are reduced drawings of actual construction, and are intended to be used by the engineering department as examples only. The dimensions shown are not required to be followed unless they are made obligatory in the text of the specifications which appear upon the page opposite to each plate.

On all plans or specifications for new construction or work by way of replacement, it must be shown that a check has been made for safety, and it has been made the duty of superintendents of plants to see that safety devices and precautions provided for in our book of standard safety devices are complied with before machinery or plants are put into operation, and that they are thereafter maintained. No new machinery or new plant may be put into operation unless it has been first approved for safety by the safety inspector, except upon the specific order of the general superintendent or assistant general superintendent of the plant. No machine tools may be ordered unless it has been shown that the plans and specifications therefor have been checked for safety.

SAFETY EDUCATION

This branch of the subject is indeed a broad one, and first I want to touch on it in generalities.

It may seem to the uninitiated as I proceed that I am wandering from the subject, but there are so many ways of reducing accidents through education, or, in other words, through building up a spirit which will cause us to think always and consistently of our own and others' safety. That is the key. A spirit or conscience, a personal responsibility and an esprit de corps that will secure hearty co-operation.

Study a number of accident reports and you will find that about nine out of every ten of them would not have occurred if some one had done some little act or if some one had used a little more care. If the driver of the street car or the motor had slowed down at the corner, the man would not have been killed—if the workman had looked before he threw down the material he would have seen the man below and warned him out of danger—if the mechanic had properly adjusted the brake instead of giving it a twist and a promise, the load would not have dropped and a man would have been saved to his family.

Let us look at this phase of the question from the standpoint of the public for a moment. Ask the average person you meet—"What is this Safety First movement?" "Is it much of a movement?" And you will be told, "Yes, it is quite a big movement; they seem to be pushing it pretty hard." He has heard about it but he has seen only the crest of the wave—he does not realize the great underlying force—that tidal wave that is being set in motion. It is still—"They are pushing it" with him. So far as he thinks, laws and safety devices are all that are necessary to protect the public, his family or himself.

For a number of years the States and the General Government have been passing laws devised to make conditions safer, but the results obtained, except in few cases, have not been very successful because of the lack of co-operation on the part of those affected. We do not feel this lack of co-operation is due to a feeling of antagonism but rather to a lack of education— to a failure to appreciate what an enormous loss is being sustained each year through accidents and how easily this loss can be reduced through education and organized effort for prevention.

The only thing that will make our industrial plants or railroads and public places safe is the development of conscience—a realization of the human responsibility.

Organizations being formed throughout the country for the promotion of safety and welfare are an evidence of a public awakening. As stated before, our public officials have not been unmindful of the necessity of proper laws, but it is not alone through remedial legislation that great results can be obtained. The public must be educated and public sentiment must be back of the movement. Our governmental organizations in co-operation with the semi-public safety organizations, through the press and through mass meetings, through talks on safety to the school children and through sermons on safety from the pulpits, can build up that public sentiment, that feeling of human responsibility. If through these different agencies we so educate the public that safety will be always first in its thoughts, the problem of accident prevention in our industries and on our transportation lines will have been solved. On the other hand, if the employer and employees who really constitute the public were imbued with an enthusiasm for safety, the problem of public safety would be very simple. It is not the calamities about which we read but the isolated cases that make the large total of casualties each year. The only cure for this is the elimination of that proneness of human nature to take a chance, and this is a duty which devolves upon the public, the employer and the employee—but we cannot say in a like degree.

The employer occupies a very responsible position with relation to accident prevention. The power to provide means of education in safety—the power to teach restraint and thoughtfulness for the safety of others, lies in his hands and he should realize that he cannot, even if he would, shift the burden of responsibility.

I am not belittling the responsibility of the employee in accident prevention but the lead must be taken by the employer. In the stress of business—in the hurry for production—a great deal depends upon the attitude of the employer and his agents. It is necessary that he have a sincere desire to prevent accidents and that he be willing to make some sacrifice to accomplish that end. It is not sufficient that he wishes there were no accidents; that he is sorry the workmen are so careless—but he should point out the way; he should lay out the plan of campaign; he should build up that feeling of personal responsibility or conscience which will make every man feel that the success of the work largely depends upon his own efforts. No man should feel that he is only a cog in a machine. If interest and co-operation are shown, and sought, they will be forthcoming.

Here is a new way of looking at it. When an employee commences to feel that his services are very valuable to the employer —that things would be in a chaos if he "quit"—he is commencing to be valuable to that employer—he is geting that "conscience" which is so necessary for full efficiency.

One of the greatest railway systems in this country owes its success, in a large measure, I believe, to the fact that every man on that system feels that the success of the road largely depends upon him—that in his way he is just as important as the president of the road, and the road fosters that spirit. I was talking with an old track walker who has a little shanty on one of the mountain divisions of that system and it was refreshing to hear him tell about the importance of his duties and how if he were not continually on the watch, his road might suffer. That is what I mean when I talk about developing a "conscience".

We condemn a man who carelessly injures another but we know he would not have done it had he stopped to think—he did not feel that personal responsibility or have that conscience which would have prevented the accident. We should teach them to think. We cannot do it in a day, or a week, or a month, and we cannot do it by merely installing safety devices and telling them they must be careful. They know that they should be careful just as well as we do—when they stop to think. We should reach them in other ways. We should get a great family spirit working among them—we should teach them the brotherhood of man. Not by preaching—they hear enough of that—but by building up *that* atmosphere around the works and carrying it so far as we can into the homes.

We know that the conditions under which we work—our feelings towards our work and our employer—has a very material effect; that pleasant surroundings and proper conditions make for better and more careful workmen and a higher standard of citizenship.

Therefore, in showing how the United States Steel Corporation and the Illinois Steel Company carry on their campaign of safety education, I am going to cover several other things besides advertising safety—things which also help to build up that great family spirit, things which help to awaken that "conscience" about which we have been talking.

Although Safety Committees are invaluable in promoting "Safety First" education, other ways also must be used to that end. We must get into personal touch with the men and keep the subject ever before them. The following are some of the methods used by the Companies with which I am connected:

Starting at the Employment Office, a man seeking employment is confronted by a sign which tells him that unless he is willing to be careful of his own and others' Safety, he need not ask for employment.

The man is given a book of Safety Rules, printed in his own language, and is later examined on them by his foreman.

We require that all Foremen pass an examination on the Safety Rules. When an efficiency of 90% or better is shown, a "Safety First" button is given. The men are also invited to take these examinations and win a button and a large number of them have successfully done so.

Over the Plant entrances are illuminated signs upon which are displayed Safety precepts. These little sermonettes are printed in foreign languages as well as English, and are changed periodically, and tend to remind the men that to a large extent they are their brothers' keeper.

The "Plant Preacher". When new men are employed a notice is sent to the Safety Department; where one or more men are employed who are versed in the intricacies of the foreign tongues, and when an employment notice is received, one of them calls upon the foreman to whom the men have been sent, and in conjunction with him talks to the men about their duties and about being careful in their work and how to avoid injuries.

When men are spelling off or at lunch hour when the men are in groups, the plant preacher improves the opportunity of preaching on "Safety First."

Gang Safety Man. Another scheme is to have each foreman appoint some one of his men to act as a Safety overseer. In addition to his regular work, this man is also on the alert for dangerous conditions, and practices, reporting the same to his foreman. The man selected to fill this post is given a badge.

Bulletin Boards. On each Plant highway and in each department, one or more of these Safety bulletin boards are installed. Upon these boards is placed material which will keep the men interested in accident prevention. Among other things are shown Stories of Accidents, narrow escapes from accidents, newspaper clippings of accidents, list of departments successful in making the Booster Class for the prior month, etc. This material, of course, is frequently changed. Stories of accidents are printed in the monthly Safety Bulletin and extra copies of these stories are made for the Bulletin Boards.

Articles Advertising The "Safety First" Idea. Buttons and Watch Fobs—Badges of distinction—given to men who are successful in passing an examination on the Safety Rules with an efficiency of at least 90%.

Prizes. When a department is successful in meeting certain fixed requirements in accident prevention records, during any one month, each man in that department receives a Safety First token. These requirements are based on past records and inherent hazards of a department.

Sanitation. As I have mentioned before, we believe there is a great deal in the psychology of accident prevention, that the conditions under which we work are material, that pleasant surroundings and proper conditions make for better and more careful workmen. Many installations of sanitary equipment have been made. Great care is used to see that these installations are not only adequate and efficient but that they are attractive and are kept in a clean condition.

Flowers. Making steel and raising flowers would have been considered as rather incongruous years ago. Now flower beds are common sights enjoyed in an up-to-date steel plant.

Steel Works Clubs. Another means of building up that family spirit is the establishment of Clubs and social centers where all may meet on a common ground and learn that those whom they imagined "wore horns" or were always "looking for the best of it," are in fact rather decent fellows.

Visiting Nurses. Visiting Nurses are employed and the influence of these good Samaritans is well known, but the value and appreciation of their services will not be comprehended until you have actual experience.

Safety Mass Meetings and Banquets. An effort is being made to carry this movement into the homes, schools and churches. Banquets are given to the clergy, and have resulted in "Safety First" sermons preached on "Safety First" Sundays, moving picture shows of Safety devices and of dangers of the street are given to thousands of school children, and general mass meetings to promote Safety are held in Club auditoriums.

You may wonder, you who have not yet had experience in this work, does all of this effort pay? The answer is obvious. Statistics show that there are 2,000,000 people maimed and 40,000 people killed each year in these United States. Statistics also show that fully 80% of these accidents can be prevented through safety education—1,600,000 people saved from injury, 32,000 homes saved from a call from the Grim Reaper—Death.

SAFETY FIRST IN A MANUFACTURING PLANT

F. S. SIMONS, '09
Chief Electrician, Avery Company

C. C. FLYNN, '11
Insurance Department, Avery Company

The "Safety First" movement was given prominence in the United States about twenty-five years ago and since that time it has had a very rapid growth. The steel mills have been pioneers in this work in this country, but it was not until 1892 that any definite action was taken by them, and not until 1911 did New Jersey lead with the first compensation law in America. This work is now developed to such an extent that even Germany with over fifty years of experience is able to receive valuable lessons from the work in the United States. The State and Federal Governments are now back of the movement and have given aid by collecting data, publishing bulletins, and helping with their money. The private corporations have spent thousands of dollars on the publication of bulletins, printed signs, motion pictures, and general educational work among their men and their families.

This work has taken such a national turn that even the schools and colleges are giving special work along this line, and in two engineering schools special courses are given which lead to the degree of Safety Engineer. These courses are strong on mathematics, mechanics, physics, economics, general chemistry, drawing and languages. One can see that our own University is taking part in the general education of the public, for placards and "Safety First" ideas in the wood shop make it evident that the present students are given a start on "Safety First" that was not given a few years ago.

For the largest success in safety work in and about any plant it is necessary for the superintendent or works manager to be a firm believer in "Safety First". Should he treat this work in a light vein, it is a very easy matter for his assistants to do the same, and in a short time this spirit of indifference is transmitted to the foremen and workmen. But when he is a "booster", it is an easy matter for the safety department to bring its work to a high standard. In small plants employing only a few hundred men, it looks as if the hazardous risks were very small, and it is sometimes a question in the minds of the officials as to the advisability of spending money on the "Safety First" work and safety appliances. Then it is that the safety department can furnish the necessary data and facts to substantiate their claims. One writer states, that, "In the United States alone over $250,-000,000 in waste occurs annually fro disability." Mr. G. L. Avery, Secretary of the Avery Company, who has charge of their safety work, has summed it up briefly in the following words: "When the bosses, so to speak, have been educated to the real value to be gained, it is then possible for cooperation at the money source."

Too much stress cannot be given to the proper selection of the safety engineer, or safety inspector. He must be a worker with men and understand men in their work, in their homes, in sickness or in health, and upon him depends a good deal the attitude that the men will take towards the "Safety First" movement. He must be a diligent inspector, tactful, and of an inventive turn of mind, and know how to plan improvements and carry them through. His organization must be complete, and his word final on all subjects pertaining to the safe methods in and about the plant. He must be able to create a spirit of confidence in his system, and lead men in such a way that they will not only be loyal to the company, but boosters for the safety department. His personal interest in all matters pertaining to the welfare of the men will go a long ways in building up a spirit of cooperation and loyalty. He is indeed a social worker, one who "believes in prevention rather than relief." And in this idea, he is well backed up by the cold-blooded facts that prevention is not a fad, but is true economy for the industrial interests.

This is well illustrated by our own experience, from an insurance standpoint. In an article contributed to the National Compensation Journal, the liability cost at our factory in Peoria is shown to be $1.888 per hundred dollars pay-roll. These figures include everything chargeable to liability insurance, such as administration expense, cost of employment department, compensation expense, depreciation on safeguards, etc. The scope of the safety work was enlarged during 1913, and the rate averaged $2.13 per hundred dollars pay-roll. The figures for 1914 are not yet ready, but will show approximately $2.00 per hundred dollars pay-roll. In these figures, insurance premiums for 1912 are between 40% and 50% of the total cost; in 1913, between 15% and 20%; and in 1914 the premiums will be slightly less than in 1913. Had we not equipped a first-aid hospital and operated it in conjunction with our employment office, it would have cost us for full coverage under the Illinois Workmen's Compensation Act $3.35 per hundred dollars pay-roll, and the same protection, including the cost of employment and administrative expense in handling insurance, costs us about $2.00 per hundred dollars pey-roll. As a result, nearly a dollar a month per man employed is saved, besides giving the man medical attention that enables him to safeguard his health, thereby rendering him a more valuable employe to the Avery Company.

The workman is looking for a safe place to work, one where the directors think it better "to conserve rather than to waste." The workmen will feel better if they know that the plant is trying to work for their welfare, and should an accident occur, they are in most cases willing to settle matters outside of court. This in itself, means less notoriety for the company and more actual money for the individual, and leaves a better feeling between the two parties, and often makes a more loyal man for the Company.

The Department Committee makes possible another point of contact between the men and the safety department. They represent the "man on the job," and often can bring out unsafe local conditions that the safety inspector would overlook. These conditions, when brought up, should be given careful consideration; and the credit should be given the person who points out the unguarded place, and if possible, he should be allowed the time and privilege to suggest or work out his idea as to its guarding, even if it is rough, for a "poor device faithfully used is better than a good device employed under protest." The committee work can be strengthened by smokers, luncheons, excursion trips to other plants, and a definite plan whereby all the available men can be put to work on the committee. The weekly reports as to new ideas, or decreases in accidents, can be published and circulated about the plant, and will tend to develop a good-natured rivalry among the different men of the department.

The safety department, if properly conducted, can be felt in all of the departments. The employment department should be cautioned to exercise due care in the proper placing of the workmen—the physical giant should be given his place, and the small alert man given the work he can handle, and each will work with safety to himself and fellow workmen, and profit to the Company. Often the very attitude of the employment agent will drive away from the plant the best of workmen, and leave only the rougher element from which to choose.

Conservative estimate says it costs over $300.00 to train a man for a new job, and care should be used in the choice of this man, and also care in his protection after he has been placed on the job.

A well-equipped dispensary or first-aid hospital goes hand in hand with the safety work. It can well be made the center from which all men may be reached. If the plant is small and does not keep a doctor in attendance all the time, he can have his regular hours and then some competent person be left in charge during his absence. Small cuts or bruises, when given proper treatment at the first will often prevent a loss of time to the Company and the man, and what might lead to serious complications.

The Illinois Compensation Law first went into effect on April 1st, 1912, and the Avery Company immediately organized and established a complete first-aid hospital and examination room, which have been operated in conjunction with the Employment office. Medical supervision, and the physical examination of employees, are "Safety First" of the first importance in preventing serious accidents and in maintaining a normal, efficient working force. The man is fitted to his job, and the job to the man, and any defects or disorders that might later be used as the basis for a compensation claim, can be entered on the physical examination record at the time. If an applicant, for example, has a bad heart, and would prove too much of a hazard to his fellow workmen, he is denied employment at that particular work. In the adjustment of man and job, therefore, due regard is had to the applicant's own safety, his fellow workmen's safety, and the safety of the Company. The purpose of medical supervision, however, is not to produce a physically perfect force of workmen. If it is found that the man's physical condition is not compatible with the type of work he had expected to do, an effort is made to place him at other work where he will be less of a hazard to the company, to other workmen and to himself. Not infrequently, special work is arranged for the injured employe, other than his regular duties, in order that he may lose as little time and wages as possible; as, under the compensation law he would receive no compensation for a given length of time; and after that, as long as he is disabled, he receives only half wages.

Proper lighting of the plant must be given careful consideration. Long, narrow, dark passage-ways are a menace to life and limb; dark, closed stairways often are equal to a treacherous pit; either can be given enough light by installing one or two tungsten lamps. The current consumption would be very small in comparison to results obtained.

For the plant running night and day shifts, or even one with much night work, the proper illumination will soon pay for its first cost of installation, by the increased output alone. In one machine shop which had been equipped with the ordinary 16 c. p. carbon lamps for years, the lamps were taken out and the shop equipped with tungsten lamps and steel reflectors. The lights were hung high and so shaded as to prevent any rays entering the eyes of the workmen. This gave good general illumination, so that one could walk about the shop and not be in danger of falling over the work on the floor. By the end of the first week, the foreman in charge made the statement that he could get out as much work at night with the new lights as he could in the daytime, and that there was an increase in night production of 50% over the old method. With such practical results, there should be no arguments that proper lighting will not pay.

Often the introduction of new lights in an old shop is a matter of education. Many of the older men are accustomed to the old "glow worms" just in front of their eyes. A sample installation over one machine will often convince the men, and in a short time they will be asking for a similar light, giving you the assurance that it will have the best of care.

Improper lighting on a lathe in one factory nearly cost the life of the operator, and as it was, the man was allowed $1500.00 compensation for the injuries received, all of which could have been prevented by proper illumination at a cost of less than $5.00.

Pilot lights for gauges, watchmen's station, fire-alarm boxes, signal buttons, hose reels and hose connections all serve as a guide for quick location at night or on a dark day. ((Large areas are well taken care of by means of the nitrogen lamp, or a cluster of tungsten lamps under the proper reflector.)

In the changing of lights and wiring, great care should be used to see that the electrical work is put up in a safe and workmanlike manner. Not only should the National Electric Code be followed closely, but care should be used to guard against any possible chance for a workman to receive a dangerous shock or burn.

Electric workers should be given special lessons on "flashovers", in first aid, the breaking of accidental contacts, artificial respiration and the proper installation of all electrical equipment. No repairs or changes should be allowed except by qualified workmen. An unsoldered joint, poor insulation, a defective socket, or an over-fused circuit will in a few seconds cause more damage than can ever be fully repaired. Regular inspection will tend to keep the electrical construction up to the best standard.

The equipment of factories with motor drive allows close control of machines, the stopping or starting of which is imperative in case of accident. It does away with long heavy belts, and the belt shafts which serve as a good chimney and give much aid in case of a fire.

The electric cranes of a plant should be given special attention, both as to operation and their operators, and also as to the movements pertaining to the work they are called upon to do in the different departments. The operator should be carefully chosen and given special instruction in regard to his work. He should be able to know something of the weight of material he is called upon to handle, the best possible "hitches", strength of ropes, chains, hooks, etc., and see to it that all rules are enforced pertaining to the safe operation of loads and use of the crane. The company should do their part and see that the crane is equipped with proper limit switches, emergency switches, guards, ladders, toeboards, signal gongs, etc. This material should receive regular inspection; and written reports given by the inspectors, repairman or operator should be sent to the foreman in charge and he in turn should send them to the safety department.

Steam boilers should receive proper inspection by competent men and a report should be kept on each boiler as to its condition. Recording steam guages serve as a check on the fireman and give a graphic record of the day's run, showing excessive pressure or pressure too low for fire pumps.

Elevators should receive the proper inspections and prompt repairs should be made on any defective parts. The cables, signal bells, control levers, ropes, and operating machinery should receive the most careful inspection. This is especially true of elevators not having a regular operator.

In the "Safety First" movement, it is of course recognized that no two plants or industries are exactly the same, and that it is impossible to give a remedy for the prevention of accidents that would fit all plants. Nevertheless the once accepted idea that each plant could meet its own problems no longer stands; for, in the long run, the lasting benefits and advantages to be derived come, and must come, through cooperation. Accident prevention, as well as fire prevention, reduces to two important factors—inspection and education. Education in these subjects is not a "one man job," but requires a high degree of cooperation, and this made most effective by organization. Before the proper spirit can permeate the plant, the officers and management must be vitally interested in the subject. And if the men are to become interested, and their interest increase, they must have a part to perform. Cooperation is essential, and it is only through organization that this is possible.

THE ESSENTIALS OF INDUSTRIAL SAFETY AT THE NATIONAL CASH REGISTER COMPANY

R. C. ROUTSONG

There are both direct and indirect forces at play which relentlessly increase or decrease the efficiency of industrial health and safety work. Regarding the indirect forces, such as the personal habits of employees, home conditions, ability to lessen fatigue by means of proper diet, rest, and recreation, and even the government of the community in which they live, we prefer to make no comments. They form a very complete and distinct field for investigation. The direct forces to be considered here might be defined in a general way as those capable of being directed by the management of a given industry. They are first, proper arrangement of buildings, machines, and materials; second, the guarding of machinery; third, the maintenance of well-lighted and sanitary work rooms; fourth, providing adequate emergency treatment and hospital facilities; and fifth, making constant and scientific interpretation of accident and illness records. It is assumed that whenever an attempt is made to carry out these suggestions, an organization exists which will give details serious attention.

The National Cash Register factory is especially fortunate because its buildings are efficiently arranged. There is ample breathing space between the buildings. They are united by means of bridges and tunnels, rendering transportation practically immune from the hazards which ordinarily accompany trucking and hauling across streets and tracks. Adequate floor space is also a safety asset. The construction engineers from the first demanded wide aisles. The lines were laid down and along with them came the order: "Thus far shalt thou go." It was early realized that if aisles and stairways are to be kept clear of stock, another convenient place must be available. So adequate floor space was made the rule.

The safe arrangement of machines can not be overemphasized. If too near the aisle, trucks are interfered with and the passerby is exposed to revolving stock or machine parts. This also applies to the crowding of machinery. In order to make safety doubly sure before power is applied to the new machine, the arrangement must be O. K.'d by our Maintenance Engineer, every possible guard must be installed by our Chief Millwright under the Maintenance Engineer's direction, and must have the approval of the job-foreman, foreman, and supervisor of the department concerned.

Pits, platforms, stock bins and piles, hoists and elevators, are all constructed with guards, railings and safety devices wherever

90 PER CENT OF THE WALL SPACE AT NATIONAL CASH REGISTER CO. IS GLASS

possible. The standard railing is of pipe, supplemented with wire mesh, especially when guarding overhead platforms. Careful inspection makes a high standard possible. Elevator cables, for example, are examined weekly and any defect reported at any time is given immediate attention. Many valuable safety suggestions coming from the rank and file point out defects which could scarcely be detected by any one other than the man on the job.

Students of Safety tell us that not more than 33⅓% of efficiency can be gained by guarding machines. While this may be true as a general statement, our company feels that a large percent of our efficiency in accident prevention is due to the installation, maintenance and constant emphasis of safety devices. The facts that the company spends money for guards, places the planning of devices in the hands of the best engineers, and is always anxious to find a new place or condition calling for guards silently suggest to employees to be careful and to think of safety first.

In the Women's Division of the factory safety work has been advanced to the extent that there is practically no "class feeling" between factory and office department employees. To guard against the crowded street cars, women employees come to work at eight in the morning and leave at five, fifteen minutes after the factory closes in the evenings. Clean sleevelets and aprons are

FOUNDRY AT NATIONAL CASH REGISTER CO.

furnished to all women. They are made to eliminate the loose sleeve and skirt hazards. Drills, cutters, and shafts are covered so that it is impossible for the worker's hair to become caught. The rest periods of ten minutes at ten o'clock in the morning and three in the afternoon combat fatigue, and to combat fatigue is to reduce accidents. To this end rest rooms are available for all departments. Alternating the work serves the same purpose. It relieves the bodily and nervous strain which ordinarly follows the repetition of any given operation.

Two of our departments demand special attention—the Woodworking and Punch Press departments. Here every possible precaution is taken both to guard the machines and to caution the men. Signs are placed on the machines and in other conspicuous places pointing out special hazards. A red ball with "SAFETY FIRST" in black letters is suspended from the ceiling. Perhaps the most effective plan, however, consists in making the job-foreman directly responsible for conditions in his section. He must be certain that the new employee is instructed, that the job has been "set up", that the machine is in good repair, and that the guards are in place before work can be started. This applies to all departments throughout the factory.

The plant is well-lighted and kept clean, in part because of the close relation between these qualities and the prevention of fires and accidents. Large windows afford sufficient natural light for every department. Eleven men keep clean 350,000 square feet of window glass. This comprises four-fifths of the wall space. The windows are washed the same way, the bolts to which the washer's belts are attached extending through the sill. When there is sufficient light, inspection is a simple task and wrong conditions, whether in the collection of trash or in the careless arrangement of stock, almost automatically adjust themselves. One hundred and forty men are trained and equipped to keep the factory clean. It is one of their most important duties to report anything found to be unsafe.

Exhaust systems carry the dust from our woodworking, sanding, polishing, grinding, and buffing equipment. To insure efficiency, U Tube readings are taken at regular intervals on the various hoods and conveyors. The company found that a reading at the time of installing a system was not sufficient. There should be some means by which to discover when and where a conveyor became clogged, a motor slowed down or was over-loaded, or a fan did not operate properly. Systematically recorded U Tube readings have solved this problem and make a standard condition possible. It is remarkable what the regular testing of equipment—and we might add—the regular testing operators, will accomplish to render dusty work "safe."

Regardless of the efforts put forth in equipping machines and educating workmen, the company has found it advisable to maintain a modern emergency hospital and a treatment room. All injuries, however slight, are sent to the hospital for treatment. This seems to be the best means to guard against infections. The treatment room is open to all employees and renders service to all who are for any reason indisposed.

All accidents reported to the hospital are carefully classified and analyzed. A separate record is kept for each department and all safety education is based upon the facts as revealed in these records. They present our safety problems in very concrete form and give direction to all safety work. It is not difficult to make suggestions for safety to a department head if his record for the past month or two shows the need for each recommendation. The scientific interpretation of accident records makes for safer conditions by pointing out practices, conditions, machines, jobs, and departments which require attention. And this interpretation of records goes farther. It opens new fields for thought and action. As we study them these questions occur to us: What constitutes the scientific method in dealing with the whole problem of accident prevention? What is the psychological explanation of accidents? What constitute the most advanced standards for industrial health and safety? We must patiently look forward to the time when there is greater cooperation between workmen, engineers, employers, and the students of industrial conditions for the answer.

ACCIDENT PREVENTION
COMMONWEALTH EDISON COMPANY

H. L. GANNETT
Inspector of Safety and Fire Prevention

"When thou buildest a new house, then thou shalt make a battlement for thy roof, that thou bring not blood upon thy house, if any man fall from thence."—Deuteronomy 22:8.

"SAFETY FIRST" is not a new thought, it is simply a slogan indicative of our recognition of an ancient admonition. "Safety First" appeals to us a rallying cry in the cause of Accident Prevention—the Conservation of Human Life. War has its horrors, with death and suffering following in its wake. We have also learned from sad experience that death and suffering attend us in times of peace, through carelessness and thoughtlessness. Men take unnecessary chances, they sometimes do things without thought as to consequences as to themselves or others. It is to overcome this that we have banded together in this great Safety Movement. The large number of preventable accidents and resulting fatalities have brought about an awakening of public conscience. All over the land in shop and school, men are laboring to bring about a thorough and wide-spread realization of the importance of accident prevention. "Conservation of National Resources" has given way to "Conservation of Human Life". The appalling loss of life and serious injury to workmen in the industries due to accidents wherein men are needlessly struck down while at work have brought about this awakening. Men are beginning to realize that their duty to their families, their fellow men and to themselves demands that they think of the consequences of their acts before they act and that they should co-operate in the Safety movement with all the power that is in them.

In this great humanitarian "SAFETY FIRST" movement, which is especially attracting the attention of large employers, the Commonwealth Edison Company has put its shoulder to the wheel and is endeavoring to do its share in curtailing this waste, privation and distress. Realizing that in unity there is strength and that to reach any appreciable degree of success, the most interested person, THE MAN ON THE JOB, should have means for united effort, Mr. Samuel Insull, President of the Company, in December, 1913, inaugurated the safety organization, by appointing a Central Committee on Safety, the personnel of which was a guarantee that the word would receive the wise consideration it demanded. An Inspector of Safety and Fire Prevention was also appointed. The Central Committee desiring to proceed along purely democratic lines in organizing, directed the forming of employes into Committees and Safety Organizations, along such lines as would allow the utmost freedom of action and permit independent discussion of matters relating to personal safety among the rank and file.

The plan adopted and which has been highly successful, was formulated in the adoption of the following:

CONSTITUTION OF THE SAFETY ORGANIZATIONS

1. The name of this organization shall be The Safety Organization of the Commonwealth Edison Company.

2. The purpose of the organization shall be to prevent accidents by securing the co-operation of the employes of the Company, by affording them an opportunity for the discussion of Safety Work and by organizing, instructing and interesting them in methods of performing their work with the greatest safety to the public and to themselves.

3. The Safety Organizations shall consist of:

(*a*) The Central Committee on Safety.

(*b*) Intermediate Safety Committees.

(*c*) Employes' Safety Organizations.

4. These several committees shall be constituted as follows:

(*a*) The Central Committee, as appointed by the President in his letter of December 8, 1913, consists of the Chairman, the Inspector of Safety, and three other members appointed by the President, and the President, Vice-President, Secretary and Treasurer of the Commonwealth Edison Section of the National Electric Light Association, Ex-officio Member—the Manager of the Bureau of Safety and, as members, such additional employes of the Commonwealth Edison Company as the Committee may elect to membership. The Inspector of Safety shall be ex-officio Secretary of the Central Committee on Safety.

(*b*) The Intermediate Committee shall consist of foremen and other employes of similar rank selected by the Central Committee. The Inspector of Safety shall be ex-officio permanent Chairman of the various Intermediate Committees, but each Committee shall, in December of each year, elect from its own membership a Vice-Chairman and a Secretary who shall hold office for one year and until their successors are elected.

(*c*) The Employes' Safety Organization shall include, in proper groups, such classes of Employes as may be designated by the Central Committee.

Each Employe's Organization shall, in December and June of each year, elect from its own membership a Chairman, Vice-Chairman and Secretary who shall hold office for six months and until successors are elected.

5. The respective duties of these various organizations shall be as follows:

(*a*) The Central Committee shall consider recommendations submitted by subordinate Committees or Organizations and any other matters affecting the Safety Movement, to compile statistics of accident cases and, by means of bulletins and public speakers, to disseminate the information thus obtained among the employes for the purpose of instructing them and keeping their interest alive in the Safety Movement.

(*b*) The Central Committee shall, when it appears warrantable, send recommendations to Department Heads, advising them of its findings and conclusions as to hazardous conditions or methods and suggesting such changes as may appear advisable.

(*c*) The Central Committee shall have full and complete authority over the entire Safety Organization; shall have its own series of account numbers; shall prepare its Budget and be accountable for expenditures.

For convenience in conducting its work it may delegate such of its duties as may appear expedient to an Executive Committee, called the Commonwealth Edison Safety Bureau, consisting of the Chairman of the Central Committee on Safety, the Inspector of Safety, the Head of the Claim Department and ex-officio, the Manager of the Bureau of Safety. The Central Committee shall meet as often as once a month.

(*d*) The duties of the Intermediate Committees shall be to consider and transmit with any recommendations to the Central Committee, any matters which may come to them from the Employes' Organizations. It shall also be the duty of the Intermediate Committees to consider any matters interesting the Safety Movement, which may be proposed by a member, and to forward to the Central Committee any recommendations resulting from such deliberations.

In order that recommendations originating either in an employes' Organization or in an Intermediate Committee may become quickly available to the Company, there shall be sent to the proper Department Head a copy of each recommendation forwarded from an Intermediate Committee to the Central Committee.

(*e*) The Employes' Safety Organizations shall meet at least once in three months to discuss matters relating to Safety and to receive and consider suggestions made by members which may tend to prevent accidents to employes or to the public. Any recommendations which may result from such discussion in these Organizations shall be sent to the Central Committee through the Intermediate Committees.

(*f*) With the approval of the Chairman of the Central Committee on Safety, special meetings of any Intermediate Safety Committee or of any Employes' Safety Organization shall be called by the President of said Committee or Organization on written request of not less than five members of such Committee or Organization and may be called by the Chairman of such Committee or Organization when he considers such meeting warrantable. Such request or call shall state the time, place and purpose of such special meeting.

Pursuant to above plan, six Intermediate Safety Committees, with an average of fifteen members, were formed as follows:

Power Plants,
Street Division,
Sub-stations,
Service Division,
Construction Division,
Transportation & Stores.

Each Intermediate Safety Committee contains in its membership, employes of similar rank from other departments whose work is such as to bring them in contact with the activities of the division with whom the majority of each of the committees are connected. By this arrangement it has been found that safety suggestions that reach a particular committee can be more readily and promptly discussed from all angles and can then be forwarded to the Ceneral Committee with a complete report for or against adoption. The Intermediate Committees also of their own initiative may and do suggest changes in physical conditions of the property and methods of performing work.

The Inspector of Safety & Fire Prevention is permanent Chairman of each of such committees; Vice-Chairmen and Secretaries are elected by the several committees and hold office for one year and until their successors are elected.

The employes of the company whose work is of a hazardous nature and those whose work brings them in contact with such work were formed into thirty-eight Employes' Safety Organizations, which elect their own Chairman, Vice Chairman and Secretary, who hold office for six months. These organizations have met at least once in each three months. Suggestions were invited from employes on all subjects relating to the advancement of the movement. These suggestions may be forwarded through their several organizations, or may be directed to the Inspector of Safety & Fire Prevention. All suggestions are acknowledged through company mail, considered on their merits and the author advised as to final action; if rejected, reasons for such action are given. We have found that the large majority of suggestions call for physical changes in buildings or machinery.

An analysis of accidents brings out the fact that but a very small proportion of our accidents are due to such conditions as are covered by such suggestions, but rather are due to improper methods of performing work or failure of the injured to properly protect themselves from injury. We have found that men are reluctant to suggest along the desired lines through timidity and fear of involving their fellows, notwithstanding our assurances that it is only by eliminating bad practices that we can eradicate the chief cause of accidents. To overcome this timidity, we are now having *near* accidents discussed in Employes' Organizations with more favorable results. There is a certain element in every workman that causes him to have considerable pride in side-stepping something, and this applies to accidents as well as to other incidents of life. Through this medium of discussion we hope to bring about a different feeling and attitude.

All meetings of Employes' Safety Organizations are addressed by the Inspector of Safety & Fire Prevention, or his assistant, and a representative of the Bureau of Safety. Accidents are described and in some cases conditions existing at time of an accident are reproduced, such as erecting an improvised pole line in a meeting room and causing men to act on the pole as did the injured at time of accident, there being no current on such improvised line. Comment is invited. The members take great interest and enter freely into discussion of the accident.

A majority of suggestions coming from employes have been adopted and further suggestions encouraged.

Every member is expected to consider himself a committee of one for the elimination of accidents.

We have found that much depends on the attitude of foremen. They have a large responsibility; they are responsible for the safe conduct of their work and should give particular attention to safe methods and practices. They should *know* that the tools and appliances which their men use on the work are in good order. They should never relax their viligance when the safety of their men is at stake. The success of safety work depends in a great measure on the co-operation of the foreman and the nature of the relation existing between him and his men. He should have a genuine interest in their welfare and never forget his responsibility as a leader. He should see that safety rules are obeyed by his men and should never break a rule himself. Before allowing his men to proceed on a job he should study the conditions and not possibilities of accident. Having determined that a job should be done in a particular manner he should give his orders to the men and satisfy himself that they understand them. He should see that all hazardous points are properly safeguarded and permit no premature removal of safeguards or disobedience of his instructions. A foreman is pre-eminently his brother's keeper and he should thoroughly understand and remember it. Many serious and fatal accidents are attributable to slackness in discipline and disregard of orders.

To further assist in the work, Safetymen have been appointed by certain organizations from among their membership to serve for two months. It is the duty of these men to observe and correct unsafe methods of doing work and conditions not conducive to safety. They render reports of their observations to the Secretary of their Organization; he in turn reports to the Inspector of Safety.

Having an organization, the success of the safety movement absolutely depends upon the degree of co-operation and enthusiasm shown by the man who is in the best position to prevent an accident—the man on the job. In our safety work it has been found that frequent meetings, posting of catchy bulletins in special bulletin boards, distribution of snappy safety slogans in pay envelopes, personal conversation with the men, articles in our company's monthly publication and system of suggestions, have been productive of very good results. The work requires constant and concentrated effort. It is a matter of education. Eternal vigilance is the price of Safety.

With the beginning of this work, we planted a seed which cannot be expected to grow and bear over night, but the fruit of which we expect to gather throughout the coming years.

The Technograph

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THE TECHNOGRAPH, Urbana, Ill.

EDITORIAL

We wish to thank those companies and individuals who have made this number of the Technograph the largest and best issue in the history of its publication. We feel that the men who have written on "Safety First" for this issue guarantee the importance of the movement. We therefore urge upon all readers to carefully read and study each article, and become members of the national committee of the whole in advocating, preaching, and practicing "SAFETY FIRST." The college man is peculiarly adapted for this work, as he goes to all parts of the world and in all lines of business. He is often in an executive position where he can enforce the principles of accident prevention. Acting in concert with the practical men of his organization, he can effect great changes for the better in conditions as he finds them. There is always room for improvement, and one of the easiest ways is to disseminate knowledge of safety work until the slogan of everyone is "Safety First" or its co-partner, "I will always be careful."

The Business Manager would like to have more applicants for positions on the business staff. Men who do not care to be officially connected with the Technograph but who know they can secure advertising will find it to their advantage to communicate with him.

We wish to emphasize upon our readers the fact that the advertisers are the men who make the Technograph possible. We urge you, therefore, to read the advertisements carefully, patronize those who advertise in this publication, and mention the Technograph when you are in their stores or in writing.

Any suggestions for the March issue should be placed in Room 100, Engineering Hall, at once. This number will feature the Electric Show.

The College of Engineering Library is short the following numbers of the Technograph: Numbers 1, 2, 3, 4, 11, 12, 15, 16, 17, 18, 20, and 21, those issued during 1910-11 except Vol. XXV, No. 1. Anyone in possession of any of these numbers will confer a great favor upon the College of Engineering if they would turn them in to Miss Manspeaker, clerk of the college.

We wish to acknowledge our indebtedness to Mr. B. W. Benedict, Director of Shop Laboratories, who has acted as consulting editor for this issue.

DEPARTMENT NOTES

E. E. SOCIETY

Since the last issue of the Technograph the E. E. Society has passed through some rather stirring periods. The Electrical Show has been the chief topic under discussion, and although at the first meeting the students were not very enthusiastic in its support, yet, under the influence of a little faculty opposition, they have all finally united in a determined effort to make this show the best ever.

The regular meetings of the society have progressed as usual with, however, a slightly smaller attendance than might be desired. The A. I. E. E. have helped materially, both by the interest they have shown in our activities and also by the instructive speakers they have brought from outside.

One of the biggest boosts that has been given the show so far was the combined smoker held by the E. E. Society and the A. I. E. E. at Nelson's Hall on the evening of December 12, 1914. This smoker compared very favorably with the feed given earlier in the year, and far surpassed all previous smokers. The crowd, consisting of about 150 students and faculty members, gathered shortly after the winning of our first basketball game, and for an hour made it their chief business to eat, drink, and get acquainted. The regulation apples, smokes, parfay, and music were served as the first course during this time. Abour nine o'clock a motion was made to adjourn to the floor above, where everybody was seated and treated to a lunch of sandwiches, coffee, and apple pie a-la-mode. It was hard to tear the boys away from this, but finally most of them again congregated on the lower floor ready for the evening's addresses. President Hermann first gave a short talk and told his story "Did yez ever bowl?" If you never heard it, ask him about it. This was followed by several other speakers who spoke very enthusiastically concerning the show and told some of their plans relative to it. Acting Dean Richards gave a good address on "Various Methods of Power Transmission." His talk covered the ground thoroughly and was much ejoyed by all. Professor Paine spoke on the attitude of students and instructors toward each other, emphasizing the spirit of friendship which should exist, and yet at the same time bringing forth many of the amusing phases of the question. The meeting closed in form with an enthusiastic account of the old show given by one of its most prominent promotors, L. A. Dole.

E. A. JAMES.

M. E. SOCIETY

At the A. S. M. E. meeting held in the Engineering Lecture room December 3, Mr. O. C. K. Hutchinson gave an illustrated talk on, "The Mechanical Equipment of a Sawmill", and the handling of lumber from the raw material to finished product.

E. S. McPherson gave a very interesting talk on "The Balancing of High Speed Gas Engines" on December 17, although not well attended, more of these addresses should be encouraged.

The new equipment of the power plant is now being used which consists of two new five hundred horsepower Babcock & Wilcox boilers, automatic stokers, link belt for the conveying of coal, a 200,000 pound Buffalo platform scale for the weighing of coal cars, and individual scales for the boilers which are electrically operated. With these facilities coal can be easily transferred from the cars on the track to the hoppers where it can be spouted to the stokers. The individual scales for the boilers will be used in determining the amount of coal used by each boiler. This new equipment aids greatly in the production of increased power and relieves the pressure which was too great for the old facilities.

L. H. SCHICKEDANZ, '16.

C. E. CLUB NOTES

The C. E. Club has been able to secure some very good talks from the students who were on the program. On the 20th of November E. K. Burton, '11, gave a very interesting and instructive survey of "Engineering Construction in Porto Rico." Mr. Burton has been on the islands since he graduated and has had responsibility of all the engineering work in Porto Rico.

"Frisco Harbor Dock Construction" was ably discussed by A. Norberg, '15, on December 11. Mr. Norberg was inspector on this work and his talk proved very instructive, especially to those interested in methods of constructing and pouring concrete in forms subject to strong tides and ocean weather conditions.

P. W. FREARK.

THE RAILWAY CLUB

Instead of the regular meeting on November 6, the club took an inspection trip to the Illinois Central shops north of Champaign the following Saturday afternoon. The trip was arranged by Mr. Keller of the Railway Department.

On November 20 Mr. B. W. Benedict of the Shop Laboratories gave a talk on the organization of the Mont Clare Shops of the B. & O. at Baltimore. During the past summer Mr. Benedict had charge of their proposed reorganization.

Mr. R. B. Keller of the Railway Department gave an illustrated talk on "The Development of the Locomotive" at the meeting of the club on December 18.

EDW. H. SCHLADER, '16.

THE FIFTH BIENNIAL ELECTRICAL SHOW

On April 8, 9, and 10, 1915, the students in the E. E. Department will put on their fifth E. E. Show in the old Armory and the E. E. laboratory. Last fall a lively time was experienced by the foremost agitators for the show, R. L. Hermann and W. S. Haggott, in getting the petition through the Council of Administration but after an enthusiastic meeting all the objections vanished. Soon the Board of Managers was chosen and the wheels started for the "Biggest Show Ever".

It is early in the game yet but nevertheless a number of exhibits and stunts are under way. One of the features of the last show, "The Electric Cafe", will be elaborated and repeated. This exhibit will occupy the center of the armory. The slogan will be "A Cuisine Par Excellence" and with beautiful lighting effects, music, and a cabaret by the Lambkins Club the Cafe ought to be the center of attraction. All the cooking will be done electrically and the spectators can go through the "kitchen" while it is in full operation.

The Panama Canal and Miniature Railway will be the most extensive exhibits of the show and of show history, for that matter. With the aid of the Government Canal Commission the production of an exact model of the canal will be made and the locking through of vessels hauled by the electric locomotives will be shown. The Miniature Railway will embody some of the latest safety appliances in the way of signals and automatic devices.

A spectacular and wonderful stunt will be the starting of an automobile, suspended in mid air, by wireless and the shifting of the gears. The fakes will be the best bunch of mystifiers that the students have ever gotten out and all sorts of impossibilities will be shown to be possible in such a straightforward and open manner that one does not know what to believe.

In the work on the show the underclassmen have shown unprecedented interest and this fact doubly assures a show that in years to come will stand as one to be patterned after.

MINING NOTES

Mining Engineers held a meeting Nov. 17, at which moving pictures of the mining and smelting of the lead ores in Southeastern Missouri were shown, as well as the manufacture of White Lead. Prof. Stock and Dr. McFarland explained the various processes shown by the film.

The Senior class of the Mining School left Champaign at noon Nov. 20, bound for Oglesby, Ill., where they were shown thru the Limestone mine of the Marquette Cement Co. as well as the mill where the rock is converted into cement. The party visited La Salle, Ill., where they visited some interesting Geological formations in the vicinity of Starved Rock. A most interesting visit was paid to the Black Hollow mine which is located in this district. The importance of the mine is due to the fact that here is seen the only example of Longwall Mining on the incline in the State of Illinois. The party then proceeded to Joliet where they were shown the steel mills and coke plant of the Illinois Steel Co., concluding their trip in the city of Milwaukee, with a visit to the new intake tunnel which is under process of construction. This tunnel extends under Lake Michigan for 4200 feet and is a circular cement structure. Its purpose is to furnish a part of the city's water supply.

The most cordial treatment was accorded the party everywhere and many valuable pictures were taken which have been made into slides for the use of the Department.

The Mining Society held their regular bi-monthly meeting Dec. 8 at which the Seniors gave a review of the inspection trip taken previous to the Thanksgiving recess. The talks were illustrated by slides showing the places visited.

A recent communication from the American Institute of Mining Engineers was received by the Student Branch of that body, causing a closer degree of affiliation between the two organizations by reason of a ruling passed by that body entitling Student members to the publications of the Society as well as the opportunities of the employment department. It is their desire to cooperate with the Student branches in securing speakers of merit for the meetings. It behooves every miner to become associated with our society. Pay your dues now.

An innovation in the Mining Society has been introduced which consists of a circular letter sent to all graduates who write of their experiences and difficulties encountered in the field. The letter is read before the society, thus keeping the members in touch with one another and pointing out mistakes to be avoided by the undergraduates when they assume the responsibilities of engineers.

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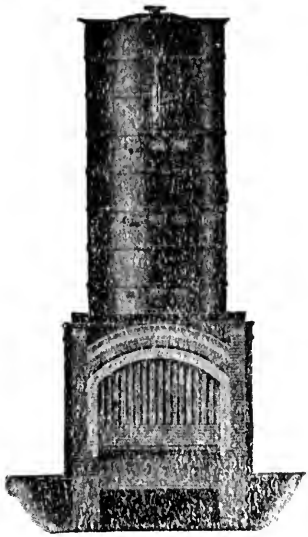

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CONTENTS

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The Technograph

Vol. XXIX April, 1915 No. 3

THE ENGINEER AS A SOCIAL FORCE*

EDWARD ORTON, JR.

Dean, College of Engineering, Ohio State University

It has been said that man is a reasoning animal. Without doubt the statement is true in both of its implications. But, admitting man's capacity to reason, it is astonishing how little of his reasoning power he devotes to the consideration of himself as a social factor in the life around him. The major part of the average man's mental activity is spent in consideration of the immediate and pressing question, "How can I secure my daily bread"? and scarcely less to the next topic, "How can I have the most pleasure or enjoyment as I go along"? Outside of the fields comprised in these two topics, the average man thinks little. This is tantamount to saying that man, in the large, is a very selfish and self-centered fellow.

Many people would take issue with these foregoing statements, and would consider that the spiritual side of man's nature has received no proper recognition in the above sordid summary. They would point out the wonderful organizations perfected by man for the upbuilding of the spiritual side of his nature, churches, schools, libraries, museums, art galleries, charitable and philanthropic institutions, and many more,—and would say that here and not in eating, sleeping or enjoyment is the real expression of his conscious life.

But after all, the good things, which lighten our load and brighten our way, and without which life would be indeed brutal, are not the product of the ordinary man's thought. They are the output of the best, not the worst, nor yet the average. It is the leading man in the community who plans such social ameliorants and betterments, the man who does think of them and who puts

*Lecture delivered before the College of Engineering of the University of Illinois, January 12, 1915.

his personality into the work of realizing such plans, becomes thereby a leader and no longer one of the average mass.

When a boy goes to college, it is very strong presumptive evidence that either he or someone responsible for his actions, is a member of that precious minority of the human race that really thinks on impersonal, unselfish and altruistic affairs. A reasonable amount of consideration of a plan of life, or a career, and reasonable forethought as to his probable place in the social scale is implied in the very act of coming to college. People who bestow no thought of such topics are usually not much interested in college. Its present pleasures are not conspicuous enough, and its future advantages are too distant or too indistinct to attract a boy whose mental caliber stamps him as one of the unthinking average. Therefore, it is fair to expect that in college we should find, if anywhere, a group of people who are bestowing serious, thoughtful consideration on the whole question of the social order of the present and future, and upon the part which they themselves desire and expect to play in it.

I feel that I cannot too strongly emphasize this first point: that the college man must be presumed to belong to the rather small minority of the human race upon whose constructive thought progress depends. It is not intended to say that there is not plenty of selfishness and self-interest, and obliviousness to these great human problems among college men. But it is intended to say very emphatically that if there is not a larger proportion of impersonal, thoughtful, unselfish consideration for the good of the community and the race here in college than in circles outside, then indeed education is a misnomer and the future is dark.

I do not want to be judged one-sided or partial in my estimate of the relative importance of college men and non-college men in this intellectual minority which originates, improves and enforces the progress of the world. We have no exclusive right of entry, no reserved seat among this body. Men of every stratum of society, of every race, of every time, have overcome all handicaps and have won their places among the world's thinkers. And college men are granted no privileges here that they cannot prove their right to.

In this circle is the truest democracy that exists. All that college life can do for a man is to favorably incline this circle to him—to assure him a kindly reception. It entitles him to the benefit of the doubt, so to speak, as to his right to enter. It defers, but does not avoid, the searching test of fitness which decides whether he shall remain in the little world of power, of outlook, of opportunity, of altruistic purpose, or shall drop down into the great mass of common people who fill the work-a-day world and pass away without leaving a mark upon its surface.

My second point is that all kinds of college instruction do not equally tend to produce thinkers in the sense in which I am using this word. By thinker, or educated man, I mean one in whom the acquisition of knowledge has brought with it a sense of obligation to use it, in part at least, for the benefit of the rest of the world: one who can by reason of his education see out beyond the narrow boundaries of self-interest and view the whole field of humanity, who can realize the sordid struggle for existence which most people are born to endure, and whose heart and mind are fired thereby to make these conditions more tolerable.

College courses are classified as general or cultural courses, and specific or professional courses. The general course has for its object this very opening up or liberalizing of a man's mind which I have attempted to indicate above. It usually does not prepare him for any calling; it is a foundation upon which a man may erect any kind of superstructure he pleases. On completion of a general course, he may begin his life work in any field, always as a beginner. His practical readiness for work of one sort, or, in fact, of any sort, is not much changed by this type of education, but he should have acquired that which is worth more than all else—the liberal mind.

How does the so-called cultural course impart this liberal attitude of mind? It is difficult for me to answer this question, for although the content of the course partly accounts for it, this is not sufficient. No one becomes liberal minded by studying any single thing or any group of things in an arts curriculum, nor does the failure to study certain things prevent a man's becoming liberally educated. Without doubt, history, literature, familiarity with the great minds that have gone before, must exert a powerful influence on any young and receptive intellect, and must help to give a bent to that intellect where it itself becomes constructive.

Another group, now presented in wonderfully able and attractive guise in the present day colleges, is the social group, economics and sociology. He is indeed heavy, whose enthusiasm for humanity does not take fire when he sits under an able teacher in social science, as now presented.

The mental philosophy group also, logic, ethics, psychology, and mental physiology, opens the mind to an appreciation of what it itself is, and how it works. But, after all, learning about things is not necessarily acquiring a point of view, and every class illustrates how very widely different the same subject matter becomes when assimilated by different minds.

I think it is only fair to say, that the largest factor in acquiring the liberal point of view consists in consciously adopting the teachable or receptive attitude to it. One may gain culture from almost any study, or even any instructor, if only one places himself in the receptive attitude. And right here, I believe, is one of the greatest and most important differences between the liberal arts student and others.

In going into a course of study which frankly makes no pretentions to producing industrial, or commercial, or professional competency, the student must at the very outset admit to himself that the gains of the course, if any, are going to be dependent upon his willingness to harbor hospitably new knowledge, new ideas, new points of view, in short, to acquire culture. And, once a boy fights out this fight with himself, and promises to himself that he will hold his mind open and receptive to whatever his teachers seek to present, half the battle is won. *The teachable attitude of mind and poor opportunities are worth fifty times more than the finest opportunities in the world and a conceited or stubborn or unwilling spirit.*

Strictly professional courses, like law or medicine, are different in purpose, content, and results from the liberal arts courses. Everything is subordinated to the idea of final competence in a specialty. And, unless the teacher himself goes more or less afield in his instruction and brings culture into the curriculum by his own personality, or unless the student has already gained a liberal outlook in his preliminary training, he is very likely to go forth in life highly trained but very little educated. Such men are a hindrance rather than a help to a community, for they expect to receive the consideration which falls to the educated man, but they can give back to the community no adequate return. Big specialists are not necessarily big men and it is big men that do things in the world.

Now, how is it with the engineer? Does the engineering curriculum in itself, from the cultural standpoint, compare with that of medicine, law, and other strictly professional schools, and does it impart the liberalizing influence of the arts course? Here, there would be a difference of opinion. I think that its place justly falls between the two. But, many would say that it is professional only, and that there is no more hope of culture coming from an engineering course than from any other professional course, and that if it comes, it must come from the teacher and not from the subject.

My reason for saying that the engineering course is more favorable to the absorption of culture than some others is based upon the fact that the engineering course is more general and less professional than other professional courses. In fact, the young man who studies engineering today is really working "in parallel" with the arts student and not "in series", since his course is not superimposed upon an arts course but is prefaced with the same preparation, and is completed with the same time allotment. Further, there is in the composition of the average engineering course not less than one-half and sometimes two-thirds of general subjects, chiefly the fundamental sciences, and some cultural elements, that would be welcome material in any arts college curriculum. Thus my contention is justified, that engineering education is more cultural in type than that of law, medicine, or other professional schools.

There is another reason for my belief in the cultural value of an engineering education, viz., that it breeds a mental sincerity or intellectual honesty which is, next to the liberal mind, the most priceless product of education. In fact, it is the very foundation of the liberal mind. No man can have the truly liberal attitude of mind, except upon the basis of intellectual honesty. But, all intellectually honest people are by no means liberal and broad minded.

I contend that the engineer, dealing as he does with the fixed facts of nature, and using in his plans, and his calculations, the most accurate knowledge he can obtain, is irresistibly brought to the habit of mental honesty. How can it be otherwise? What does it profit to "fudge" an analysis, or to leave a bad closure in a survey, or assume a wrong strength of material, when we know that the error lives till it is corrected and vitiates everything in which it is used? There is no satisfaction in fooling oneself, and the engineer, who must be honest with himself, becomes honest by habit with the world as well as himself.

Intellectual honesty, sound scientific training, development of strong reasoning ability, and power of continuous application are the lawful and legitimate products of an engineering training. But, the attitude of open minded receptiveness to culture is not emphasized in an engineering course and hence the engineer may, with all of his practical efficiency, take his degree with the gates of his mind still closed or but half ajar to the blessed influence of true culture. He must desire it, if he is to get it. If he does desire it, he will get it.

In the title of my article, I mentioned the engineer as a social force. What does this imply? To me, it means leadership of men. A man is justly called a force in a community only when he is a leader of men. He may be a good leader or a bad one, but unless he is a leader, he is not much of a force for either good or evil. The actions or opinions of no one are important except in so far as they are able to control or influence the actions and opinions of the masses, who cannot take the initiative themselves.

In what way does a man make himself felt as a leader? Well, there are many kinds of leaders, of course; but the kind that rise most easily to one's mind, such as political leaders and social leaders, are not the kind that I should encourage young college people to emulate. At least this is not the type of leader that the term is most often used to describe. The kind of leadership that I have in mind is not necessarily leadership in either church or state, in either law or levity, though it may be in any of these fields. What I do mean is that quality to which men instinctively defer, that unselfishness in the consideration of the public's business, which makes one forget his private interest. This quality may be found anywhere, in the professions or out of them, among the educated and the working classes, in men and women, and it ought to be more often found in college people than in any other sort.

In what position is an engineer to thrust himself into such leadership? In a splendid position, say I. The key to such leadership is service—disinterested public service, and can any class of men make themselves more serviceable to the public than engineers?

The civil engineer is intelligent upon what his community needs in the way of water supply, of sewage disposal, of good streets and highways, of good bridges, of good transportation facilities, of protection from floods and storms, of permanence in establishment of locations and boundaries. If any of these questions is to be settled in a community, who is so competent to advise the people as the civil engineer, if only he be broad minded and sincere? He will have to establish his disinterestedness as a preface to exerting any influence, but if he has done so, who can compete with him in the public confidence in settling such questions?

The mechanical engineer is informed upon the manufacture and utilization of power, the development of transportation systems, the development of large groups of industries, etc. Consider how often cities undertake to make power and sell it, or to buy power from private sources, without any adequate guidance in the real economy involved. How can a city decide such things wisely, except when the clear brain of some adequately trained engineer has cleared away all the irrelevances, and bared the problem in its naked fundamentals.

The electrical engineer has his large list of questions of public policy in his field also. What sort of illumination ought a city to have? What sort of a fire alarm, telephones, telegraphs, lightning protection, safeguards against electrolysis in public and private structures? What sort of power circuits and how distributed, and what sort of electric transportation?

The mining engineer has a duty of most urgent public importance to perform. He alone knows what is being done with the mineral wealth, which is the people's after all, tho in our short-sighted system in America it is temporarily committed to the wasteful stewardship of private control. Other wealth is more or less created by men, mineral wealth is not. It is here to be utilized, once and for all, and waste is irretrievable.

The chemical engineer is the people's mentor in the many questions involving purity of materials, quality of the materials bought under specifications, protection from chemical frauds and the undertaking of chemical absurdities. Any man may form an opinion on some sort of engineering problems, but no one can have the least opinion about a chemical statement except the chemist.

I have thus far mentioned only those things in which the engineers are specifically instructed and in which they are bound to have definite opinions. But, in other public questions which do not come specially in any single engineering field, or perhaps in no engineering field, is it not perfectly logical to expect that the engineer's training will make him more competent to grasp them and deal with them effectively than a man whose training has been less rigorous and in whose curriculum descriptive and speculative subjects form a larger part?

It seems to me that the educational value of the descriptive and speculative subjects is largely cultural, and as such, entitled to our most respectful consideration, but when it comes down to actual creative work on the solution of problems, such subjects are far inferior to the exact sciences. And therefore, while the engineer may lack the vision which the cultural course makes possible, nevertheless his hard common sense and insistance on basing all action on definitely known foundations is of the utmost value to society.

Our public men at present are so largely made up of lawyers and others of non-scientific training, that the injection of the advice of the public spirited engineer into public affairs can only have the happiest results. He ought to be able to avert many mistakes, to prevent the expenditure of public money in ways that cannot fail to lead to success, and to act as a wholesome check on visionaries and idealists, and at the same time to lead the way in many other reforms where physical and chemical laws are fundamental. If the problems of society are to be settled, then leaders must be found who will lead the public on the right way. If competent leaders do not arise, then less competent ones will settle these matters for the time, at least. Is it not a pity, is it not a shame, if the engineer, the man whose preparation in so many respects is the strongest of any class of educated men, does not make his leadership strongly and increasingly felt?

We have heard a great deal about "the white man's burden" and "the black man's burden"; but the people are the educated man's burden, and the engineer is an educated man.

How do the engineers of the past and the present measure up to their opportunities and their duties in this matter?

As I run over, in my mind, the names of some of the famous engineers of the past, I am struck with the fact of how comparatively little known to the world in general their names are. Scientists, poets, historians, musicians, warriors, kings, explorers, physicians, artists, all sorts of people, have writ their names on the scroll of fame. But how many engineers do we find there? I suppose Newcomen, who first made an effective steam engine, has done as much to relieve mankind as anyone who has lived in the past two centuries—but how many people in an ordinary audience would know who Newcomen was? The case of James Watt is a parallel. I suppose the name of Robert Stevenson would be more generally recognized as the first man to achieve success in steam locomotion, but I presume he figures on the roll of fame as an inventor rather than an engineer. How many people know anything about Smeaton, who built the Eddystone light and discovered Portland cement? Or, Sir Henry Bessemer, who first placed steel on a tonnage basis. De Lesseps, the brilliant Frenchman who built the Suez canal, and who miserably failed in his attempt at Panama, will be remembered for a while, but the irony of the situation is clear, when we find that he was a good deal of an idealist and dreamer, who failed because of his inability to handle a difficult problem after succeeding with a relatively easy one.

Coming down to the present day, who knows the names of the chief engineers or the chief of the motive power divisions of our great railways? We know the names of Collis P. Huntington, and Jay Gould, and William Vanderbilt, and Pierpont Morgan, and James J. Hill, but who knows these men as engineers, or who knows the engineers who made their work possible?

Let us turn to the cities. Is the city engineer of an American city considered on a parity with the mayor, or a councilman? And yet he tells the mayor what he can do, and what he cannot do, and his decision stands no matter how the council roars when some half-baked plan of public improvement is punctured. Who thinks of the city engineer, except as an irritating official who makes people move obstructions in the street, or to put down new cement sidewalks where they have perfectly good brick ones?

In business, it is a little better. Corporation officials usually consider their engineering department rather carefully and are usually careful to follow their advice in the main, but after all it is only as experts on the physical side of the problem that the engineers are used.

This certainly sounds discouraging. If an engineer, even an eminent one, can only hope to be a sort of high grade technical advisor to men whose fitness to lead the public mind is clearly less than his own, the question is, "*Why be an engineer?*" But we must be cautious in reaching such a conclusion. Things don't usually "just happen" in this old world, and if we find the railroad president can get the public ear, while he still has to depend upon the judgment of his engineer staff for every important decision he has to make, we are very likely to find that there is a reason. If we find everywhere, in all sorts of enterprises, that the engineer furnishes the definite knowledge of what to do and how to do it, while others are known to the public as the leaders, it is because the leader has some quality which outranks mere knowledge of physical facts and methods. If the engineer's *competence* could command the public attention, then he would be the leader, but it ordinarily does not. A little clear thinking now will be necessary to bring us to the answer to this riddle. As I see the case, it is like this:

(A) Men cannot be led by reason alone. The appeal to their sentimental or imaginative side is absolutely necessary to leadership. The engineer's training all the way thru is such a gruelling drill in being exact, definite, specific, in short in being right on everything he does, that it breeds out this imaginative, heroic, sentimental side of his nature, and leaves him a very useful tool for somebody else to use.

(B) The engineering curriculum at school leaves too little room for cultural subjects. It makes too little appeal to the imaginative side of our students' natures. Young engineering students are possibly as full of romance and imagination as the average, but they get mighty little encouragement to use it in their work, and it dies a natural death ere they walk out of college with their diplomas, *nicely graduated sticks!*

(C) Many of the students entering our colleges of engineering, however, are seriously defective in their ideals, viz.: They are in deadly earnest to get a job, or get ready for one, in the shortest time and with least work. Their conception of engineering is a strictly bread and butter conception. They shy from anything outside of what they think is necessary to their business, as if extra knowledge was poison. The idea of studying anything not in the curriculum never occurs to them, and is resisted if suggested.

(D) The remedy for this is clear to me. The two qualities necessary to leadership which engineering training does not specifically give, and which most engineers don't get, are culture and altruism. Engineers have done a large part of the work in making the world the comfortable, livable place that it is, but they have not received a large part of the credit for it. It is their own fault. They have let others solve the social and human problems, while they have thought in terms of materials. Those who have had the culture, the altruism, the public spirit, have been the social force in their communities. And, they will continue to be, until the engineer shall meet them on their own ground.

Show me the engineering student whose attitude to culture is one of respectful receptiveness, and I will show you one who will become cultured. Show me the young man who gathers in his four years at college the vision of service to his fellowmen—who labors to gather more and more knowledge and a riper and maturer judgment, that he may more powerfully do his part in advancing the cause of civilization and righteousness—who feels the responsibility of the educated minority to help those less fortunate or less able, and I will show you the kind of an engineer who *will* become a social force. Show me the student who acquires, with his technical knowledge of engineering, the culture of the true gentleman and the altruism of the great Nazarene, and I will show you one who will build structures of men's souls, as well as with senseless wood and iron and stone.

Young Gentlemen: If you do not become powers for good in your respective spheres after you leave college, it will be your own fault. All that is needed is the desire—the will to be so—all else lies ready to your hand.

THE ENGINEER VS. RHETORIC

A. F. COMSTOCK

Associate in Railway Engineering

A recent report by a special committee of the engineering faculty, headed by Professor Baker, on the subject of rhetoric instruction for engineers is of great import to every engineering student. The proverbial antipathy of the engineer toward rhetoric seems likely to be doomed, if the committee's report is finally approved and its provisions enacted. Greater emphasis is to be placed upon rhetoric, a higher grade of accomplishment insisted upon, and, incidentally, a method of dealing with delinquent students is proposed which is a distinct departure from present practice.

There are two main recommendations in the report. The first would make Rhetoric I a prerequisite for Junior standing, while the second would empower engineering instructors who find a student's written work unsatisfactory from a rhetorical standpoint, to report the case to the rhetoric authorities, who, after consulting with the student, might prescribe, if deemed necessary, additional work in rhetoric which the delinquent would be required to take preparatory to proceeding in his course and as an additional requirement for graduation.

Neither of these recommendations has been formally approved. The indications are, however, that both will find ready support among the engineering faculty, although it is entirely possible that the second recommendation might ultimately be vetoed, even though approved by the engineering faculty. Its chief interest at this time is as an evidence of the stringent measures that the faculty apparently feels justified in adopting in order to insure more fruitful results from the study of rhetoric. Several minor recommendations deal with other phases of the matter which will not be here discussed.

By insisting upon rhetoric being taken early in the curriculum, it is hoped that its importance will be more properly emphasized, and that the student will be compelled to rid himself of his most glaring faults in diction before habit too firmly fixes them in his mind. Then, by insisting upon a reasonably high standard of written composition throughout the various technical courses, with recourse to a penalty for failure to continually measure up to this standard, it is believed that a more creditable quality of written and oral expression will result.

Criticism of college curricula and methods of instruction by large employers, when intelligent, is generally helpful to a college faculty. One of the most persistent criticisms of the engineering graduate (and this implies the curricula) has had to do with his inability and unwillingness to undertake duties not strictly confined to the engineering department, or to a particular branch of the engineering department. The charge has been made by those competent to judge that our engineers are too often wanting in culture and breadth of vision. While this is a serious indictment, it has been returned from too many sources to be seriously questioned. The increasing amount of attention which the matter is receiving from engineering organizations and faculties throughout the country, is witness to its importance.

A frank yet able analysis of the engineers' shortcomings is contained in an address by Mr. George F. Swain, Professor of Civil Engineering in Harvard University and Past-President of the American Society of Civil Engineers, before the American Institute of Electrical Engineers, Feb. 17 last. A general discussion of the status of the engineer took place at this meeting, and was participated in by several eminent engineers and teachers. Professor Swain held that deficiency in personality is largely responsible for the engineer's failure to receive recognition commensurate with that accorded the lawyer and the business man. A plea was made for greater emphasis upon fundamentals in our college curricula, with more attention given to cultural subjects, and this opinion was shared by Dr. Alexander C. Humphreys, President of Stevens Instiute of Technology and Past-President of the American Society of Mechanical Engineers.

It is a singular fact that Professor Swain's remark concerning the engineer's failure to receive recognition has been iterated, with one exception, by all of the six speakers who have addressed the College of Engineering so far this year. The statement is fast becoming hackneyed, although its truth is unquestioned.

Definite steps for bettering the training of engineers so as to obviate the foregoing criticism of lack of culture must be taken. Examples are not wanting to show that engineers, given the desire for true culture, ever have been able to obtain it. Furthermore, the practice of engineering is not known to contain any antidote to culture. The whole difficulty aparently centers in an attitude of mind. There appears to be no good reason why aptitude for mathematics and science should spell dislike for rhetoric, economics or philosophy. Our young engineers must realize that they are preparing for a profession—not a trade.

The recent changes in our engineering curricula whereby nine hours of non-technical subjects are introduced, really constitute a step in the general direction of broadening the student's viewpoint. The proposed recommendations regarding rhetoric contemplate another step in the same direction, although this time by endeavoring to arouse a more wholesome and receptive attitude of mind toward a subject already in the curriculum.

The attitude of engineering students toward rhetoric has been very generally characterized by boastful if not arrogant indifference. This fact is confirmed by long observation from many different quarters, and is the only plausible explanation of the astonishing paradox of how the average engineering senior manages to keep himself so nearly immune from the advantages of several courses in rhetoric which he has pursued along with several years of almost continuous reading of books.

As an excuse and alibi for this callous indifference on the part of the student, we hear many statements like the following: "I don't like the instructor. I don't like the text-book. I don't like the theme subjects. I don't like rhetoric." Personally I have scant sympathy with the originators of such remarks. Having spent some years in intimate contact with many young men deprived of even the rudiments of an education, without the assistance of an instructor, or a text-book or any of the numerous advantages within the reach of a college student, and having seen some of these men, with all of their handicaps—by sheer grit outstriping some of the whining college graduates about them—my patience is easily strained by excuses which begin with the words "I don't like" or "I can't".

Besides the direct loss in specific knowledge that results from an indifferent or unfriendly attitude toward a subject, there is perhaps a greater indirect loss which every student should foresee. To pursue a subject in a half-hearted way for any length of time is almost certain to leave an indelible habit in the individual, which, later on, readily attains proportions which may seriously curtail his usefulness and opportunities.

Another mistaken idea which has gained some vogue is that there is a special brand of rhetoric called "rhetoric for engineers". To a certain extent rhetoric may be taught in an utilitarian way, but not to the extent commonly supposed. There is probably no more difficult writing than pure technical writing. If a student wishes to begin on a difficult thing, he should begin by describing a machine or a drafting table, but he should understand that unless he has had a good previous training in rhetoric, the task is almost like taking calculus without having had algebra. Our best technical writers, with few exceptions, have been men who were well schooled in ordinary, every-day writing before turning to the technical. There may be some justification for teaching utilitarian rhetoric where a student's interest can be gained in no other way, but it is doubtful if the process can be defended upon any other ground.

In concluding, I wish to call attention to another aspect of the engineering student's attitude toward rhetoric and the other subjects not related to exact science and mathematics. All of us must do things occasionally which we do not like to do. Employers rarely ask us if we would like to do so and so. As long as no compromise or dishonor attaches to doing these things, we are expected to perform them with the same cheerfulness and care that we perform other duties. The student who refuses to become interested in subjects which the faculty prescribes or recommends, is more than likely to be the same man who, after graduations, incurs the disfavor of superiors through his persisting in the same unfortunate attitude. As a matter of fact, many employers are growing caustic in their criticism of various phases of this "I know better" attitude on the part of young college-trained men, and every student will do well to fortify himself against it in every possible way.

THE STARTING OF GASOLINE AUTOMOBILES BY ELECTRICITY

I. W. FISK

Associate in Electrical Engineering

For the past three years a gasoline driven automobile has not been considered complete without the so-called electric self-starter. This equipment, while very convenient when in operating condition, has given no little trouble to operators during the stages of development. These troubles were due perhaps more to the highly complicated systems that were first put on the market than to any fallacy in theory.

At the present time gasoline driven automobiles are started electrically with as little attention given to the starting system as to many other parts of the machinery. As is generally the case with any new development there is a large number of different makes of electric starters on the market at the present time. This accounts for the fact that practically every automobile manufacturer uses a system differing, though only slightly, from that used by his competitor. This is done perhaps more for selling purposes than for any real operating advantage in one system over the other.

It is not the purpose of this article to compare the relative advantages of a large number of systems but rather to point out the main differences in the two general schemes that are commonly used to-day.

In the two systems there will be found the following apparatus. System A.

1. An electric generator which produces current and delivers it to the lamps, storage battery or both.

2. A storage battery which receives and accumulates energy from the generator. The battery may then deliver this stored energy to the starting motor or the lamps or to both at the same time as occasion demands.

3. The starting motor, which receives power from the battery, slowly revolves the engine until ignition takes place and the engine runs on its own power.

Besides these three principal units the system in general includes the following auxiliary apparatus.

1a. A solenoid so arranged in the battery-generator circuit that the circuit will be opened when the voltage of the generator is

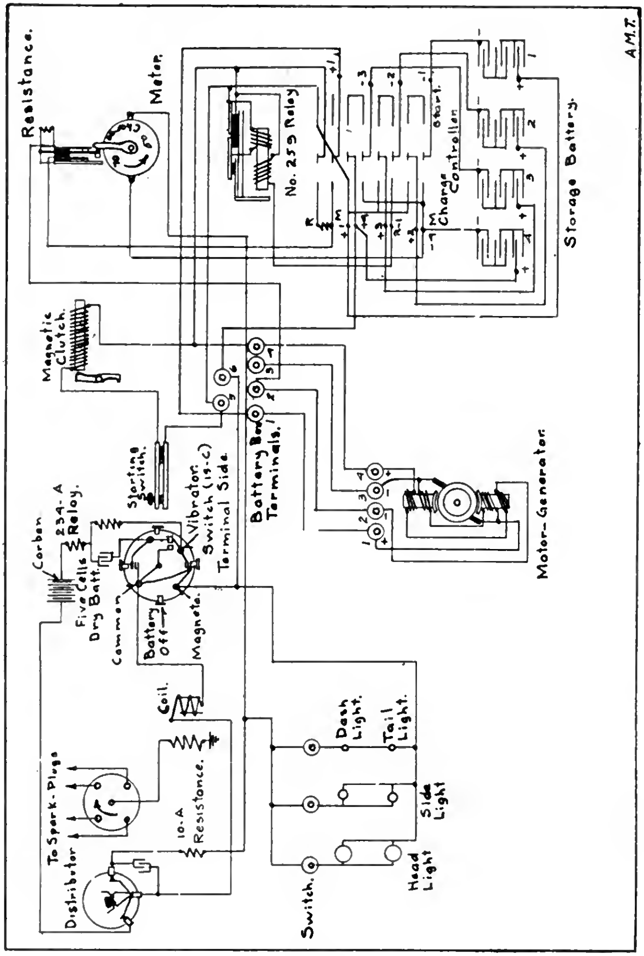
Resistance.
Meter.
No. 259 Relay
Start.
Charge Controller
Storage Battery.
A.M.T.
Magnetic Clutch.
Starting Switch.
Battery Box Terminals.
Motor-Generator.
Carbon
234-A Relay.
Five Cells Dry Batt.
Vibrator.
Switch (19-C)
Terminal Side.
Common
Battery Off
Magneto.
Coil.
Resistance.
10-A Resistance.
To Spark-Plugs
Distributor
Switch.
Dash Light.
Tail Light.
Side Light
Head Light

FIG. 1.

lower than the voltage of the battery. This must be done in order to prevent the battery from discharging thru the armature of the generator when the engine is standing still or when the speed is low. The above statement might lead one to believe that since the generator voltage is proportional to the engine speed, the charging current would also be proportional, and therefore small at low speeds and very high at high engine speed, a condition which would soon cause battery trouble. This, however, is remedied by so designing the generator that the maximum charging current is limited to some predetermined value, irrespective of the engine speed. In many automobiles the generator and solenoid are so designed that the battery starts charging at a low rate when the car is driven at about nine miles per hour and the charging rate increases to a maximum value when the speed is about 25 miles per hour (high gear transmission assumed). The solenoid is so designed that while it closes the circuit and allows current to flow from the generaator to the storage battery at a car speed of say nine miles per hour, it does not open the circuit until the car speed has been reduced to eight miles per hour. The reason for this is as follows; suppose that the switch did open and close at the same car speed, and suppose the car to be driven for some time at this particular speed. The switch, which is usually small and light, would then vibrate between its open and closed position very rapidly, throwing it out of adjustment and burning its contacts from the electric arc produced each time the circuit is opened.

2a. An ammeter, which is usually located on the dash where the operator may read it at any time. The object of the ammeter being to show whether the system is operating properly. When the car speed has increased to nine miles an hour the solenoid closes the generator-battery circuit and a current should flow from the generator to the battery. This is indicated by the movement of the ammeter pointer to the right, a distance which is proportional to the amount of current being delivered to the battery. Now, if the car is driven at any speed below eight miles per hour the generator-battery circuit should be open, there should be no flow of current and the ammeter pointer should point to the zero mark at the center of the scale. Again, if the car is stopped and lights are desired it is seen that the current must come from the battery, and therefore the ammeter will show discharge and the pointer will deflect to the left of the zero by an amount proportional to the current supplied to the lamps.

Finally, it is possible to supply the power to the lamps from the generator directly if the amount of power needed corresponds to

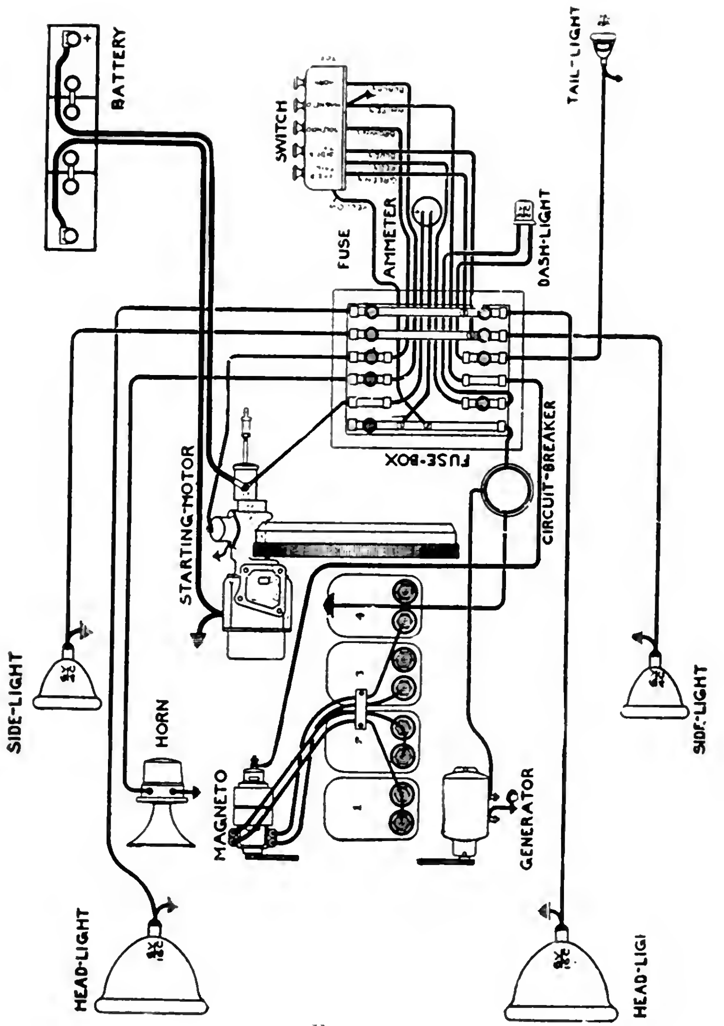
BATTERY
SWITCH
FUSE
AMMETER
DASH-LIGHT
TAIL-LIGHT
FUSE-BOX
CIRCUIT-BREAKER
STARTING-MOTOR
SIDE-LIGHT
HORN
MAGNETO
GENERATOR
SIDE-LIGHT
HEAD-LIGHT
HEAD-LIGI

FIG. 2.

the engine speed, and under these conditions the ammeter will again read zero. Therefore we see that the ammeter is a good guide to the working condition of the equipment.

3a. The control switch. This is used in many installations, first to connect mechanically the starting motor to the engine, and second, to close the motor-battery circuit. The final step allows current to flow from the battery into the motor which in turn cranks the engine until ignition takes place as stated above. The control switch is then released. A spring action opens the electric circuit and disconnects the motor from the engine. This completes the total operations of an electric lighting and starting system.

System B consists of practically the same equipment, the general exceptions being:

1. The motor and generator are built as one machine. This is made possible due to the fact that the direct current dynamo is reversible in its action. That is, the dynamo will deliver current as a generator when driven by mechanical means, or will deliver mechanical power when supplied with electric current.

2. The control switch does not connect and disconnect the machine from the engine as this type of motor-generator must be permanently connected to the engine either thru gears or by a chain.

The disadvantage of this system is, probably, the loss caused by the constant rotation of so large a machine as the motor-generator. The motor, since it develops a large power, must be large compared with the generator capacity needed. For instance, on one particular system the motor receives, when starting the engine, approximately 300 amperes at 6 volts or a power input of 300 x 6 = 1800 watts. This corresponds to 2.42 horse power. The generator used with this system delivers a maximum current of 12 amperes at 7½ volts or a maximum power output of 12 x 7½ = 93½ watts, which represents an output of 1/8 horse power. Thus it is seen that the motor capacity must be much greater than that required of the generator. If now the motor was used as much of the time as the generator, it is evident the battery would soon be discharged. This is, however, not the case as the time required to start the engine is small in comparison to the time that the engine is in operation. The above, therefore, shows the disadvantage of rotating the large machine when only a small amount of generated power is needed for charging the battery. One automobile owner using this type of starting system made the statement that the gasoline consumption of his engine was reduced 20% when the starting system was disconnected.

In the starting systems as used at the present time the storage battery is undoubtedly the weakest link. This is due to the fact that the battery is very much overworked when supplying power to the motor for starting purposes. The battery when performing this function may be required to deliver 300 amperes for from 5 to 30 seconds, while the normal discharge rate is 10 to 15 amperes. It is, however, not the total energy taken out that causes the trouble, but rather the rate at which the energy is withdrawn.

The voltage of the batteries used in different systems varies from 6 to 24 volts, with a tendency at the present time toward the 6-volt system, because 6 volts is correct for lighting purposes, as the lamp filaments for a given candle power at 6 volts are stronger than for the same candle power with a higher applied voltage.

In the 6-volt system the cells are charged and discharged in series; thus each cell is sure to receive its proportion of energy from the generator. In other systems, as for instance a 12-volt unit, the 6 cells are very often connected in series for discharge purposes, and 3 in series with two sets in parallel when charging. This scheme often leads to serious trouble caused by one cell becoming shortcircuited. If one cell in this type of battery connection does fail the group containing the three good cells will discharge into the group containing the shortcircuited cell with the result that the voltage of the system will be materially reduced, and the cells in the group that were originally good will soon be ruined if the trouble is not corrected.

Figure 1 is a wiring diagram for one of the more complicated B systems, and illustrates how difficult it may become to locate a short or open circuit in this net work of conductors.

Figure 2 is a wiring diagram for an A system, the simplicity of which is self evident.

In conclusion it may be said that the electric starter is rapidly approaching a satisfactory development and even at the present time there are many systems of both the A and B types which are giving excellent service when not abused by the operator.

COAL WASHING

CARL WENDEL

Adjustment—Efficiency of the Washer

There is hardly a material which differs so much in every conceivable may as coal from different coal fields, or even from different seams in the same field.

It is, therefore, obvious that a very careful investigation be made on any coal before a washery is built or the plans passed upon, as otherwise, later on, it will cost more money to adopt the plant for its work, after it has been put into operation, than money spent beforehand in investigating, and in conjunction with that, a well designed and carefully worked out plant, which would perhaps cost more in original outlay of money, would undoubtedly later on prove to be more economical in operation.

It is very difficult to convince a prospective owner and operator of a Coal Washing plant that this is so, as without question as a general rule, the man who has the handiest arguments and the lowest price will get the contract—and his arguments based upon nothing but generalities.

When investigating some new machine or process for the concentration of coal, I have many times been told, even before the party has seen the coal to be tested, that: "We can do that."

For instance, it was desirable to reduce the Sulphur in a coal containing a fine flakey Sulphur—about the most difficult proposition there is—and I would be asked, "How much Sulphur does your coal contain?" "About 2.60%." "How much of this is combined?" "About .9%." "Oh, we can do that."

Invariably I have found that this premature statement was wrong. In saying so, I do not mean to convey the idea that the particular washing apparatus or jig could not ultimately do a certain thing, but it surely would take a great deal of experimenting on *large quantities of coal* to finally adjust and change the machine so that it might do the work.

And here is one of the main points—that of adjustment.

I will say that almost any jig on the market will do the work at least as far as the concentration of Ash is concerned, if adjusted right for that particular kind of coal.

It is to be noted that hardly any machinery sees as hard service as that of coal washing machinery, and therefore, it is of utmost importance that the construction of the various kinds of machinery which goes to make up your installation is carefully analyzed, and it is not enough, as far as you are concerned, to know that the specifications tell you that a crusher so and so or an elevator of this or that capacity be installed, but go into details and find out from the various manufacturers which particular make will best answer your purpose, and then change the specifications and insist that you get equivalent value.

It is no particular fun to shut down your whole plant on account of a pulley slipping because there was no key, or when a crusher gets choked up and parts break and belts fly off when it could have been prevented by a breakpin at a suitable place.

Most coal washing plants are built so that if one unit stops the whole plant shuts down, and the unit which most often gives you trouble is some little bit of a part tucked away where you cannot get at it readily, and which in itself, represents perhaps, a very insignificant sum of money—but your delay certainly means money, since it means lessened tonnage, wages to your men, perhaps coal burnt up under your boilers, waste of water and often coal, since you may have to flush out part or all of the system in order to get at the broken part, etc.

If you contemplate washing a certain coal, and you know that somewhere a washery is working on a similar coal, that is, where the Sulphur is distributed through the coal in about the same way, and is of about the same size and formation, and the slate also is similar, that is, of about the same hardness and crushes up in the same way, and lastly acts in the same way when subjected to immersion in water for a certain time, then it is a wise thing to make an investigation of this washer for yourself. When doing that, it is well to have in mind, "Believe nothing you hear and only half what you see."

When doing this, it is natural that merely looking on upon the performance of the washer does not tell you much and intelligent sampling of the various products should be made which samples later on should be analyzed in the chemical laboratory.

Not very long ago, I visited a coal washing plant somewhere in the South. I, and my friends with me, had a letter of introduction from the owners to the man in charge—who by the way, impressed me as being a very capable man—and upon presenting our credentials, we were cordially received, and told to ask any questions we wished.

So I asked, "What is the ash in your raw coal?" "22%." "What do you wash to?" "Oh, about 6%." "That is very good, how many percent of Refuse do you get?" "Oh, about 9%."

So I figured out that the Refuse must hold about 150% ash and when I mentioned that he "came right down," and I got the honest and generally customary answer, that, he *did not know*.

And still this man handles perhaps a couple of thousand tons of coal a day, representing as many dollars or more in that time, and each percent or ton of Refuse costs just as much as the mined coal, plus overhead cost of washing.

As the machinery in the washer is improved upon and new methods are introduced which means higher efficiency, it is imperative that the working force in the washer is also improved upon, and it is earnestly to be hoped that the operator shall realize this and endeavor to employ a skilled class of labor and mechanics commanding good wages, insuring of the best results at all times.

Right here it might be of interest to show a simple equation by which a theoretical yield can be calculated when knowing the percent of ash (or sulphur) in any of the three products, or, when having the percent of ash or sulphur in any two products, and the yield is known, how to get the theortical percent, ash or sulphur of the third product.

R — % Ash in Raw Coal
C — % Ash in Washed Coal
T — % Ash in Tailings.

$$\frac{100\,(T - R)}{T - C} = \%\ \text{Yield}$$

Example: Ash in Raw Coal = 13.0%
Ash in Washed Coal = 7.0%
Ash in Tailings = 65.0%
% Yield of good coal?

$$\frac{100\,(65.0 - 13.0)}{65.0 - 7.0}\ ;\ \frac{5200}{58} = 89.655\ \%\ \text{Yield.}$$

Or

Ash in Raw Coal = 13.0%
Ash in Washed Coal = 7.0%
Ash in Tailings = x
Yield of good coal = 89.655%

$$\frac{100\,(x - 13.0)}{x - 7.0} = 89.6$$

$$100\,x - 1300 = 89.6\,x - 627.2\,;$$

$$100\,x - 89.6\,x\ 1300 - 627.2\,;$$

$$10.4\,x = 672.8\,;\ x = 65.0\%\ \text{Ash in Refuse.}$$

Note:

If the Ash in the final refuse falls below 60%—investigate.

Going back to the investigation of the washer and the sampling there are two ways of treating these samples so as to get results which tell the story.

One, is to make Sink and Float tests on your samples, and the other, is to size and analyze them in the Chemical Laboratory.

The first method, of which more later, which is the shortest tells you that things are not satisfactory, or satisfactory, as the case may be, but the second method will tell you:

First: On what size of coal the best washing is being done.

Second: How to crush your coal so as to get the best results.

Third: Obviously, what size or sizes to omit.

This sizing should be made on general samples of the various products, so that a true percentage of the various sizes can be had and all of them of the same weight.

The bulk of your coal is crushed, say, to ¾″ size (I am here speaking chiefly of coal which is being treated for metallurgical purposes) and you then screen your crushed Raw Coal on for instance, ¾″, on ½″, on ¼″, on ⅛″ and thru ⅛″. The same weight of Washed Coal is sized the same way and by analyzing the two coals for ash and sulphur, you find out where the best reduction lies.

You may find out that the fines in the raw coal in themselves contain the least ash and sulphur and by comparing the raw coal analyses with those of the washed on the same size, say thru ⅛″ you find that the reduction in ash or sulphur on this size is so small that it does not warrant the expense of washing.

The rational thing is then to screen this size off before washing and add it dry to the washed product later on. Or you may find that the bulk of the raw coal should be crushed finer. Suppose that it was crushed to 1″ and you find that the best reduction lies in the sizes around ½″. Naturally, you then should try to crush the coal so that the bulk produced is to this size.

Example "A"

Washed Coal Showing Poor Results on Fines.

	On 1″	On ½″	On ¼″	On ⅛″	Thru ⅛″
	33.08%	22.72%	19.82%	8.49%	15.89%
% Ash	7.32	6.43	6.48	7.38	14.39

This shows that the fines were not benefited by washing even if the fines in the Raw coal held the highest percentage of ash, as it did in this particular case.

Example "B"

% Ash—Raw Coal 13.07	% Ash—Washed Coal 8.71		
Sieve Test Raw Coal—On ¼"	On ⅛"	Thru ⅛"	
24.73%	28.03%	47.22%	
% Ash 18.90	13.20	10.85	
Sieve Test—Wash Coal 28.94%	30.17%	40.86%	
% Ash 10.49%	9.69	8.56	
% Reduction 44.5	36.2	26.6	

NOTE:

Reduction on coarser material as compared to that of the finer.

Example "C"

Screening Test on Raw Coal.

	On ¾"	On ½"	On ¼"	On ⅛"	Thru ⅛"
	7.52%	16.27%	21.86%	20.87%	33.48%
% Ash	16.80	12.86	12.09	11.66	17.07

This example shows how the Ash varies in the different sizes. Most likely in this case, less oversize on the ¾" would be beneficial but that might increase the fines below ⅛" *which are not benefited by washing to the same extent as the oversize.*

For a coal of this kind, it is imperative to use a crusher installation which produces as little fines as possible, *and this rule holds good in most cases.*

Importance of Crushing of Coal to the Proper Size.

The proper crushing and maintenance of the size which gives the best results is a very important part in the washing process, as without this, we get away from the fundamental principle of concentration, viz., specific gravities versus size.

This latter I will not touch upon, as you all know about that, and I will confine myself to the practical application of washing.

It is generally known, and I have, I dare say, invariably found that the coal below ⅛" is not benefited by washing to the same extent as the coarser coal, and that these fines, in fact, impair the good results which otherwise might be had on other sizes.

This is especially so where the slate has a tendency to disintegrate in the water.

When you treat a coal containing such slate you will find it difficult to keep the sieves of the jigs in working order as they soon clog up and ridges are apt to form, etc., which all tend to destroy the free action of the jig. In such a case, it is very important—although seldom done—that these fines are treated by themselves. I believe that the best method is then to wash these fines on a Feldspar bed, as indeed all and any fines.

"Hindered Settling" would give good results on any fines of whatever description, but as the conversion cost at present times would be too high, we will omit such apparatuses.

Again, tables might be used to advantage for fines and especially where a small tonnage only has to be treated. One table in particular seems to give good results, especially for the re-washing of primary refuse, and I understand that as much as eight (8) tons per hour per table is being treated at a plant in the South.

The main thing, though, is simplicity in installation, and that can only be attained where as few various parts, and as few different types of machinery, as possible, are being used. Therefore, see to it that all elevators, conveyors, sprocket chain and pulleys and gears are of as near one type as it is possible to get, as that will make them interchangeable and also reduce the spares.

It will also be simpler to break in a man to know how to care for one set of machinery, as compared to where a number of different types of machines and parts are being used.

Care of Jigs.

As much as it is necessary to maintain an even crushing of the Raw Coal at all times, it is just as necessary to watch the sieves on the jigs so that they do not get over-loaded with scrap iron or sticky clay, and also to know that the sieves are properly fastened down as the slightest loose action in them means impaired washing.

When a sieve starts to get away from its fastenings, it will not be long before it is gone entirely, and then you have the extra job of also cleaning out the jig body which very quickly fills right up with solid coal.

It may also be found that too large quantities of fines go thru the sieves into the jig body. This may be overcome by using a heavier bed, and as a general rule, the heavier the bed, within certain extents, the better the washing, but hand in hand with that goes a smaller tonnage over the same jig.

Recovery of Fines.

The bugbear of all coal washing is the recovery of the fines or sludge. In a great many washeries, no attempts are made to recover the fines, or what amounts to the same, the water, or where it is done it is made in a very inefficient way.

In Europe, again, the recovery of the fines has been brought up to a very high standard, and costly installations are employed while in this country, the extravagance in letting things go to waste is enormous. Times are changing and it is up to the engineer to show where a saving can be made—not in dollars, but in cents. Obviously saving the cent will save the dollar.

It is natural that the well organized companies with capital behind them take the lead, and by doing that they may sooner or later force the other parties to do the right thing.

Suppose a washer is treating one thousand tons of coal a day and no recovery system for the fine coal is being used. At least 241,000 gallons of water would flow down the creek in that time, containing about 3% of coal of the tonnage treated (this figure founded upon actual practice), or 30 tons of coal per day worthy at least as many dollars.

Thirty Dollars ($30.00) per day would certainly pay interest and amortization on a recovery system even if the money for the same had to be borrowed, not to speak about the preservation of the natural resources, as that much less coal would have to be mined—in some cases at least.

The most common means employed for the recovery of the fines is an elevator boot of indifferent capacity, sometimes provided with baffle plates. Again, settling tanks of rectangular shape provided with a slow moving scraper or screw conveyor for the removal of the sludge are used and if made large enough, they are efficient.

The overflow water is then fairly free from fines, and is well suited to be used over and over again. In other places, the washing water is pumped direct back to the jigs from the large elevator boot and if the hutch-work is re-washed, the loss should not be very large.

It may be of advantage not to use over again the water from the re-wash jigs, as the fine sulphur held in suspension in the water may be high. In such a case, you may find a stream running away from the washer although the case is not as bad as it may look at first sight.

The proper thing would be, in many cases at least, to nevertheless clarify this water, if for no other reason, to prevent the streams or creeks from unnecessary contamination. In many places, this is imperative as the state laws forbid contamination of any flowing waters.

Large conical settling tanks are also efficient. The point to take into consideration here is to place them as low as possible as that will save power in pumping against a certain head, and it may be of advantage to syphon out the sludge.

Another good way is to employ a number of "Spitzkasten" where the water overflows from one into another and where the sludge is removed from the bottom by gravity or by a centrifugal pump connected up to the bottom discharge of all of them and pumping this sludge to the re-wash jig, to the secondary coal or to the washed coal as the case may be.

Another advantage of this system is that if the jigs are set high enough, all the saturated water can flow by gravity into the settling system and pumping is saved on that point, although naturally, the clarified water will have to be lifted up required height for re-use on the jigs.

It is not easy to determine which system shall be used and local conditions must be taken into consideration, but it is wise not to place too much reliance in a statement that in such and such a place all the coal is recovered and not a drop of water goes to waste, as this cannot be done, as even where a system is used by which no water is allowed to escape from day to day the time surely comes when the system has got to be cleaned out, and an entirely fresh supply of water provided for.

The system, therefore, where a certain amount of water is allowed to escape from day to day and where this amount is constantly being replaced by fresh water, may be just as economical and under certain conditions preferable.

I cannot at the present time give the approximate settling area for the saturatored water as practiced in this country but herewith some figures compiled from the latest work of Professor Jungst of Clausthal, Germany.

Tons Washed Per Hour	Area of Total No. of Spitzkasten in Sq. Ft.	No. of Spitzkasten	Sludge Produced per hour Cu. Ft.	Gals. of Water treated per hour
100	730-1370	3-6	28-140	*96400-241000
150	920-1850	5-8	56-210	144000-361500
200	1850-2800	5-12	112-280	192000-482000

*4 to 10 tons of water per ton of coal.

Sampling of Coal and the Sink and Float Test. The Secondary Product.

Where no practical washing tests can be made on a coal in order to determine the advisability of washing, the Sink and Float test is resorted to.

As early as 1858, did Sir Henry Bessemer suggest that specific gravity solutions be used on a large scale for the separation of coal and slate, and still earlier was the method used by Berard.

At the present time, the method is used solely as a laboratory substitute for washing, and as a means for finding out the division line between on economical or uneconomical washing where a coal of unknown qualities is concerned, it is of great value.

Before going further I wish to mention that the method has been applied in practice in this country by J. R. Campbell, Chief Chemist, H. C. Frick Coke Company, and that results obtained on his washer, as far as separation was concerned, were very good.

The Sink and Float test is also employed as a means of finding out how much coal is contained in the refuse and how much good coal there is in the secondary product.

To rely absolutely upon what the Sink and Float tells us in regard to probable results later on, when it comes to washing on a large scale, would be futile, and the claims of some washer expert when he compares his Sink and Float tests with the results on the washer, and dwells upon his "100% efficiency", should be taken with a grain of salt.

As a rule, it takes at least a couple of months to properly tune up a new washer and even then it is impossible to maintain ideal conditions, since ideal conditions do not exist in the whole coal washing game.

How can it, since, for instance, the crushing changes with the moisture in the coal, and the sizing with it, if sizing is employed?

Suppose that the coal is shipped from some distant point and that dry weather prevails. This then affects the coal and also the washing as considerably more water is needed when the coal comes extra dry as compared to when under normal conditions.

I go so far as to say that the Sink and Float test means very little to me, unless I know the methods employed when making the same. While the same specific gravity solution may be used by different parties making tests on the same coal, but at different locations, the results may—and will—vary for the reason that no two men conduct their tests in the same way, as far as I know.

For instance, one man uses a large sample and stirs the sample for a long time in the solution, while another party uses a small sample and merely wets his sample.

The ultimate results certainly cannot come out the same.

One man uses a narrow receptacle, and another, a wide one, and again, we get a different solution of the problem.

Not until the Sink and Float test has been standardized as to specific gravity of the different solutions for various products, the size of the sample, the time of immersion and last, the shape and size of the receptacle, not until then, will the Sink and Float test really mean anything to the engineer who has to pass upon questions relating to the efficiency of the washer.

G. R. Delamater, Consulting Engineer, Harrisburg, Pa., has done a great deal in order to standardize the Sink and Float test, and deserves credit for this work.

On a visit to Birmingham, Alabama, I discussed this subject with a well known chemist and Consulting Engineer, Mr. Hancock, and he also pointed out the importance of the careful sampling which has to be made if the Sink and Float test is to have any value. For instance, if a small sample only is taken and used for the test, a large piece of slate may entirely upset the results and the man making the test is powerless to do anything since he cannot begin to pick out his material. He, himself, uses a twenty-pound sample, if I remember rightly, which shows that painstaking and hard work are needed in order to insure of tolerably reliable results.,

The importance of careful sampling can, therefore, not be exaggerated, and the larger the original sample is, the better.

I mentioned that the Sink and Float test was valuable in finding out the composition of the secondary product.

This secondary product is really the best criterion there is on the washing as it is evident that if there is a large amount of real good coal in the same or an equally large amount of pure slate or both, the washing is poor, and the mere fact that the secondary coal is high in ash is no guarantee of good washing.

The re-wash jig or the third compartment in the three-cell jig is for the purpose of separating and saving the bone coal which is too high in ash to go with the washed product, but at the same time is present in too large quantities, to be discarded with the refuse.

If it is desirable to wash for such a low ash in the good coal that it is of advantage to produce a secondary product, the problem may come up, where the division line lies between an economical percent of secondary coal or an unprofitable one.

The question may also arise if it should be better to wash for two products only, that is, add the secondary coal to the washed coal with a resultant higher ash in the washed coal, but with a higher yield of this product, or will it be more profitable to wash for three products.

The answer is difficult to get at before actual washing has commenced as the percentage of this secondary product is more or less problematical.

Another thing to be considered is the B.T.U. value of the washed product, and also the influence the higher ash coal may have upon the blast furnace operation.

Discarding the two latter questions, we will briefly analyze the problems, one of which has been exaggerated in order to better point out the difference.

Example "A"

86% Washed Coal
8% Secondary Coal
6% Refuse

Cost of Raw Coal—$1.00 per ton, Conversion cost—$.05 per ton. Value of Secondary coal per ton—$0.75.

Then—100 tons Coal washed—$105.00
8% Secondary Coal— 6.00

$$\frac{105-6}{86} = \$1.15 \text{ per ton Washed Coal.}$$

Example "B"

74% Washed Coal
20% Secondary Coal
6% Refuse

Then—100 tons Coal Washed—$105.00
20% Secondary Coal— 15.00

$$\frac{105-15}{74} = \$1.21 \text{ per ton Washed Coal.}$$

Example "C"

*91% Washed Coal
9% Refuse

The: $\frac{105}{91} = \$1.15$ per ton washed coal.

*Secondary coal added to washed product.

The examples, however, do not give the whole story, as we wash for Good coal and not for Secondary coal.

For instance: Example "A".

In 10 hours we wash 1000 tons of Raw Coal.

Products:

86% Washed Coal
8% Secondary Coal
6% Refuse

Example "C"

Products:
91% Washed Coal
9% Refuse

In the first case, we get 860 tons of washed coal in 10 hours, and in the second case, 910 tons of washed coal in the same time.

As this is done in two different washeries, and with the same force of men, the cost per ton of washed coal in Example "A" should be higher than in Example "C" but it is to be noted that the cost per ton of washed coal depends largely on the value of the Secondary coal and changes with that.

Mechanical sampling and quartering should be the ideal way and not very long ago I saw a new automatic quartering machine invented by Mr. Robert Hamilton, Consulting Engineer, Brown-Marx Building, Birmingham, Ala. This machine should be a valuable asset in the laboratory and for instance, at an institution like your own Mining laboratory.

For the automatic sampling and quartering of coal, etc., where large quantities of material go over a belt, as for instance, at the coke plant, I have here with me a print showing a machine which will automatically sample and quarter down any quantity from one ton per hour down to 8 to 9 lbs. and automatically return the discard to the conveyor.

It is then possible to speak about a *sample* as the ultimate 50 or 60 pound sample represents minute quantities continuously quartered down from many tons of material, in themselves representing perhaps several thousands of tons of material, the collection and hand quartering of which would be out of the question if manual labor was to be employed.

The Drying of Washed Coal.

The more extended use of the modern by-product coke oven is bound to a certain extent to revolutionize the coal washing as many of our poorer coal fields can be utilized when washed for ash and sulphur, and these coal fields which formerly were considered non-coking have been found in many cases to make fair coke. The ease of regulation of the modern by-product coke oven with its high heat, as compared to the imperfect and wasteful bee-hive oven has made this possible.

We shall, therefore, more and more wash coal for metallurgical purposes in difference to washing coal for the commercial market, that is, for firing of boilers and the heating of houses, as a great deal of this coal, in the form of coke will ultimately be used at our blast furnace plants and foundries.

This means that the bulk of the coal will have to be crushed finer than formerly when it is to be washed and the moisture in the washed coal will play a great role since this should be delivered to the coke plant as dry as possible or at least drier than it can be made by the simple use of drain bins.

When it comes to washing coal on a large scale, the cost of installation of drain bins of a large enough capacity to give the coal a reasonable time in which to drain off the moisture, would be prohibitive.

A simple and efficient way is to utilize the railroad car as a drain bin and to rely upon the weather and the longer or shorter time the coal is in transit in order to get rid of the surplus moisture. This may be very good in the South, where there is no freezing weather, but even so, it is hardly fair to expect the railroad to handle more or less water without remuneration and where the coal washery is close to the ultimate destination, this "system" cannot be used as there would not be time enough for the moisture to properly drain off.

Suppose that 2000 tons of crushed washed coal are shipped 365 days of the year for a distance where the freight rate amounts to 80 cents per ton of coal and that the average moisture in this coal equals 12%, and suppose that this coal could be mechanically dried before shipping, to 6% moisture.

The saving in freight on moisture alone for one year would equal $35,040.00.

Suppose also that the washed coal is being delivered to the by-product coke oven holding on the average of 12% moisture. It is natural that this moisture takes a certain amount of room in the oven, which if the coal was drier, could be replaced by coal and this moisture has also to be driven off with an extra consumption of gas, or else a longer coking time has to be used in order to properly coke the coal.

It has been found that the weight per cubic foot of coal diminishes with the increase of moisture up to a certain point or what amounts to the same, a wet coal takes up more room than a drier coal.

Experiments have been conducted in order to find out how much this difference in weight between a dry and moist coal would amount to and it is to be seen that there is a steady decrease of weight per cubic foot of coal as the moisture increases. The experiments were made on a coal crushed to about 85%

thru ⅛ of an inch, and it is to be noted that this weight will vary within certain limits for different kinds of coal.

Percent Moisture in Coal	Weight in lbs. per cu. ft.
Dry	60.5
1%	58.9
2	58.8
3	56.1
4	55.0
5	53.6
6	52.3
7	51.3
8	50.2
9	49.0
10	47.9
11	46.8
12	45.6
13	44.7
14	43.5
15	42.5

There is, therefore, in this case a difference in weight in one cubic foot of coal of not less than eighteen pounds.

Let us see what this means to the by-product coke plant.

Suppose that each oven holds 460 cubic feet of coal and that 160 ovens are pushed every 24 hours, also that the coal is charged holding 12% moisture.

The total chage in that time is, therefore, 460×45.6×160= 3356160 lbs. or 1678 tons.

If then this coal, instead, was charged containing 7% moisture, the figures come as follows:

460×51.3×160=3775680 lbs. or 1887.84 tons.

This, then, would make a difference of 209.84 tons of coal per 24 hours in favor of the drier coal, and this gain is had without a single man being added to the working force of the coke plant.

I will not try to show what it would mean to increased by-products or coke yield since it does not come under the subject at hand.

If you were to go into the files of the Patent office you would soon find out what an enormous amount of time and money have been expended upon the problem of centrifugal drying.

In the year 1912, a large company in this state succeeded in devising a centrifugal drier, after several years of experimenting which at last does the work in a rational and economical way.

This drier is now in practical use and has been in operation long enough to prove its good qualities, and herewith a description of the same . . . .

You will readily understand the importance of the solving of the problem of mechanical drying, and I may add that the washed coal has got to be charged into the modern coke oven holding a lower moisture than could be had by the use of drain bins since the higher moisture would be very injurious to the oven wall which is often lined with a silica brick.

Time does not permit me to go into technical details of the machinery used in coal washing nor the various methods used and abused, but I shall feel gratified if above short outline of the "game" will help ever so little to bring about better conditions, when you as Engineers are called upon to assist in the design and planning of the coal washing plant.

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EDITORIAL

On account of the character of the copy which has been handed in to the Technograph for each issue, we wish those who submit copy would follow as closely as possible the following:

Typewrite all copy, if possible.

If written by hand, write carefully and legibly, in ink.

Use paper cut to 5½" x 8½", writing the long way of the paper. This is the standard copy paper and is the most convenient. Paper cut larger than this size must be folded, which takes time, and time costs money.

Be careful of the spelling. This is one of the worst faults of the copy of upper-class engineers.

Observe the rules of punctuation and capitalization carefully.

Be sure your copy is correct before submitting it to the printer. Alterations are very annoying to us and the printer alike. It is easier and cheaper to edit the copy than it is to edit the proof.

Write on one side only. Avoid excessive interlining and marginal notes. Make all alterations and erasures clear to the printer. Indicate all paragraphs by the use of the paragraph mark. Draw a ring around all instructions to the printer. Use the correct underscore marks to indicate CAPITALS, SMALL CAPITALS, and *italic*.

Do not paste or pin inserts on another sheet of copy. Write them on a separate sheet and indicate where they go by figures enclosed in a circle.

THE HOBO ENGINEER

I sometimes think that I will quit this life,
And settle down and get a wife, by Jove!
Sometimes I think that I would love
To have some place to call my home,
And settle down, no more to roam;
But, then that very thing I've tried
And found myself dissatisfied.
I've often tried to settle down
To office work and live in town,
And act like civilized folks do,
Take in the shows, and dances, too—
But I'd no more than get a start
Till "wanderlust" would seize my heart
And in my night dreams I would see
The "Great White Silence" calling me,
And, at the chance I'd never fail
To drop it all and hit the trail.
Back to the solitude again,
With transit, level, rod, and chain,
To lead the simple life once more,
And do the same things o'er and o'er,
Day after day, and week after week.
Sometimes we go to town to seek
A little fun; and sometimes, well
Sometimes we raise a little hell.
We don't mean to, but then you see
When we've been out two months or three

In silent places where the face
Of white man seems out of place,
Well, when we hit the Gay White Way
Our joyful spirits get full sway.
We try to crowd into one night
The joys of many months; 'tain't right?
Well, maybe not, 'tis not for me
To shape our final destiny.
But when our last survey is done
And tied up to the Great Unknown,
And to the Chief our records brought
Of lonely work, with dangers fraught;
Of hardships cheerfully endured
That best results might be secured,
Against all this, our little sprees
Will seem as ponds compared to seas,
And the Angel surely will decide
There's a balance on the credit side,
And God, I think, will drop a tear,
And bless the "Hobo Engineer".

—A. K. FOGG.

DEPARTMENT NOTES

THE E. E. SHOW

Eight years ago the Electrical Engineering Society launched on what was thought to be a precarious adventure. The Society undertook to stage their first Electrical Show. Probably the deciding factor in determining this step was a desire to demonstrate by means of an exhibit that the Electrical Department was alive and wide-awake. As is the case with many great things, the first show was a small undertaking. However, financially this first show was a decided success, and as a result another and slightly larger one was given the following year. Again success attended and shows were given in 1910 and 1913. All of these four shows were held in the Electrical Laboratory. The last one in 1913, however, proved that the Electrical Show has outgrown the Electrical Laboratory. Consequently, this year a larger floor space was sought with the result that both the Old Armory and Electrical Laboratory are to be used this year. With this increase in floor space it has been necessary to increase the number and quality of the exhibits. Little difficulty has been occasioned along this line and the 1915 Electrical Show promises to uphold its motto, "Bigger and Better".

Special attractions have been prepared this year besides the usual standard exhibits and freaks. Yet despite all this increase in quantity and quality the admission price remains the same. Such a combination is a surety of the success of the 1915 Electrical Show.

PANAMA CANAL

While there is only one world noted Panama Canal which is the engineering marvel of the age, there are two miniature models of this great ditch which approach the Canal itself in completeness of detail. One of these is at present at the Panama-Pacific Exposition at San Francisco, and it is one of the great drawing cards of the fair. Many of us will not be able to attend the fair but still we can see one of these two great models of the canal, as the other will be shown at the Electrical Show here in April. This model will work in every respect exactly as the canal itself. In fact the designers of the model have used the mistakes of the original builders as valuable experience in the designing of the model. The model has been designed and constructed here at the University. Both the Atlantic and Pacific oceans and all lakes as found at the canal will be represented in miniature. Two ships, which will make daily trips thru the canal, will be actually raised and lowered and towed thru the locks. The power for towing will be furnished by small electric motors. The canal will be lighted by miniature lights and lighthouses. Small models of towns and villages will further grace the banks of the canal connecting the turbulent waters of the Atlantic with the calm surface of the Pacific.

TESLA COIL

A twelve-foot induction coil has been constructed under the supervision of R. E. Hart, '15, and with it he plans some very interesting and marvelous demonstrations. The coil will give 2,500,000 volts, which will generate a spark ten feet long. With this high voltage and frequency many amazing sights will be staged. Flame will be shot from different parts of the human body, also lamps will be lighted in a circuit of which the human body is a part. The ten-foot spark will be passed between two people who, it is hoped, will live to tell their grandchildren of the marvelous feat.

ELECTRICAL FOUNTAIN

For a centerpiece in the Armory, an electrical fountain designed and built here at the University, will be used. The entire booth given to this exhibit will be decorated to denote a Venetian garden surrounding the fountain. Special attention is given to the light effects and multi-colored lights will intermittently play upon the rippling water. Overhead a fourteen-foot Geisler tube will furnish a dull rose colored light which will cause the Venetian garden to appear as an ideal setting for the traditional lover of Venice. This exhibit is due to the genius and work of R. W. Parker, '15.

WIRELESS AUTO CONTROL

Among the interesting features of the 1915 Electrical Show will be the wireless control of an automobile. The car will be located on the north side of the Old Armory.

Even though the rubber tires are a good insulator, the car will be mounted on glass blocks to further insure no electrical connections through conductors. The principle of the exhibition is simple and very similar to the wireless telegraph. The necessary auxiliary apparatus consists of the sending and receiving instruments. The receiving instruments will be placed in the car, where their operation can be witnessed by the public. The sending apparatus, which will also be subject to public inspection, will be located in the northwest corner of the Electrical Engineering laboratory. In the complete operation of starting and stopping the car, there is considerable exhaust gas. The plan is to start the car every fifteen minutes during the hours of the show, if these exhaust gases do not materially affect the atmosphere of the armory. In order that the patrons will have some way of knowing when the car is to be operated, two clocks which are running in synchronism, will be used. One of these clocks will be placed in a conspicuous place at the sending end and the other at the car. Since these clocks are in synchronism, they run exactly together, so that whether you are in the Electrical Engineering laboratory or the Annex, you can tell exactly when the car will be started.

THE ENGINEERING DANCE

The Engineering Dance Committee has been chosen from the various engineering societies, and is now hard at work getting up the best that has ever been given under the auspices of the College of Engineering. The dance is to be held in the Old

Armory on the evening of April 30. Turner will furnish the music for the occasion.

Let every one in the Engineering College join hands in making this dance successful. Let it be a rousing farewell dance for the Seniors and a "Get Acquainted" dance for the Juniors, Sophomores, and Freshmen. It is a hard task to give a successful dance, and has been especially so for the last two years, so let us boost it all we can. So once more, GET A DATE FOR THE ENGINEERING DANCE. Ha, that's the stuff, men! Hats off to you! We knew you would do it.

The following men have been appointed on the committee:

C. E. Club—A. K. Fogg, Chairman; J. E. Demuth.
E. E. Society—W. E. Haggott, V. F. Dobbins.
M. E. Society—L. F. Armstrong, R. C. Maley.
Arch Club—H. H. Walters, B. H. Dirks.
Railway Club—G. H. Pike, T. W. Dieckman.
Mining Society—J. H. Griftner, J. M. Silkman.

M. E. SOCIETY NOTES

"From Molten Steel to Automobile", was the title of a four reel motion picture production which was given before the student branch of the A. S. M. E. on February 25, in the engineering lecture room. This production was made possible by the "Maxwell Automobile Company", it being an illustration of their plants and their mode of manufacturing. The lecture room was crowded by people eager to see how a modern automobile is manufactured. The room was taxed to its utmost capacity; even standing room was at a premium.

Considering the program from the student's viewpoint, it was very beneficial. The motion pictures illustrated the modern ideas of shop management, efficiencies, and modern shop machinery. More programs of this nature would be interesting and also highly beneficial.

At the regular meeting on March 11, Mr. H. T. Scovill spoke on "Opportunities of the Mechanical Engineer in Cost Accounting". Mr. Scovill, being a man of wide experience in shop management and cost accounting, handled his subject in a very interesting and beneficial manner The meeting closed with the members discussing business matters concerning the society.

E. E. SOCIETY

The Electric Show is but three weeks away and things are beginning to hum about the E. E. Lab. Exhibits are coming in from manufacturers and the students are very busy getting ready their several stunts. A few of the greatest attractions are: A Tesla Coil, giving a ten-foot spark at 2,500,000 volts; The Panama Canal in Miniature, A Wireless Controlled Automobile, and An Electrically Operated Refrigerator. The usual number of freaks and mystifying stunts will be in evidence. Everything promises a much better Electric Show than ever shown at the University.

The Society has had several well attended meetings in the last three months. The first meeting of the new year was held in the E. E. Lab. Jan. 15, 1915. Prof. Provine of the Arch. Eng. Department gave a very interesting account of his work in connection with the Big Creek Power Development in California. The talk was illustrated by several good lantern slides and Prof. Provine gave some interesting facts about the work on this power development which is to supply current to Los Angeles, 240 miles away.

At the joint meeting of the A. I. E. E. and E. E. Societies Feb. 12, 1915. Prof. Paine gave an interesting and instructive talk on condensers. He gave a brief history of the condenser and showed a test on a new type of condenser just put on the market.

On Feb. 26, Mr. Biegler addressed the society on "The Spokane Water Power Development". Mr. Biegler has taken active part in this work and had a stock of information that was of considerable interest to E. E.'s.

At a special meeting of the E. E. Society in the Engineering Lecture Room, March 3, Mr. E. C. Lof of the General Electric Company gave a very good talk on "The Electrical Equipment of the Panama Canal". The lecture was illustrated by lantern slides and three reels of moving pictures. A record crowd attended this meeting and the room was packed to the doors.

Prof. S. W. Parr, of the Chemistry Department, addressed the Society on the evening of March 12, in the E. E. Lab. His subject was "Some Interesting Phases of Electro-Chemistry". The speaker outlined the development of the electro-chemistry industry and showed processes for the production of the more rare metals such as chromium, tungsten, and magnesium.

At a special meeting, held Jan. 22, the following officers were elected for the second semester: President, W. S. Haggot, '15; Vice President, R. V. Waller, '16; Treasurer, W. T. Reace, '15, and Secretary, R. A. Harvey, '18.

H. R. RICHARDSON.

THE RAILWAY CLUB

The semi-annual election of officers was held at the meeting of January 15. The following men were elected:

T. W. Dieckman—President.
A. M. Tower—Vice President.
E. M. Richers—Treasurer.
E. H. Schlader—Secretary.
W. B. Golden—Sergeant-at-Arms.

The club is justly proud of its record for the past semester. All the meetings have been well attended. At the present time the club has the largest membership in its history.

The first meeting of the club for the second semester was held March 12. This meeting was called by the president to arouse interest in the club for the semester. As a special drawing card it was decided whenever possible to have the talks illustrated. It was decided to have a banquet some time during the semester, and a committee was appointed to make the arrangements.

THE EVOLUTION OF THE ARC LAMP

Few people whose eyes meet the glare of the modern arc lamp know much of its history. We won't attempt to give dates, but simply show the steps which brought the arc lamp to us as we now have it. The evolution as shown in this exhibit is in the form of five arc lamps of different types from the old open arc brush type to the modern long burning vertical feed lamp. As above stated the oldest type on exhibition is the open arc Brush. In its time it did very well but later improvements have laid it aside. It was expensive, noisy, had a low candle power, and gave off an excessive amount of ultra-violet rays, which are injurious to the eyes. Those objections led to the development of the enclosed arc lamp which belongs to the second group. It was found that by enclosing the arc, making it more or less air tight, the combustion of the carbons was more perfect and gave a better illumination and was less expensive in operation due to the long life of the carbons. The next step was the appearance of the miniature arc lamp. As the name implies it was designed on the principal of a small arc and a low current thus reducing the cost of operation. It was a good light in some respects but did not show as marked improvement as some of the preceding. For this reason and others it was never in very extensive commerical use. However, it has its place in the history of the arc lamp. The fourth step brought forth the inclined trim flamed arc. They were produced by the desire for lamps of greater brilliancy and intensity of illumination. This was attained by specially prepared carbons and changes in general designs. This brings us to the type of arc light which we have today. This, the long burning vertical feed type has slight improvements over the preceding type and so superseded it.

We have on exhibition one of each of these types of lamps. They will be in consecutive order and all burning at once, showing the differences in candle power and construction. An exhibitor at the booth will be glad to answer questions and show details of construction and differences.

ELECTRICAL CAFE

Plan your course through the show so that when you are most tired and fatigued you will find yourself at the main entrance to the Electrical Cafe. This will be found to occupy the northeast corner of the old Armory. On entering you will find it roomy, cool, and comfortable, beautifully illuminated and decorated. It has a floor space of about twenty-five hundred square feet. The arrangement is to be very similar to that of high class cafes. There will be seating capacity for two hundred, seating four at each table. On each table will be found an elaborate menu of delicious things to eat. It is our aim to give you excellent service and perfect satisfaction. We have an experienced chef in charge and speedy waiters to take care of your orders. All items requiring cooking will be cooked by electricity, giving you clean, sanitary and quick service. All things come from the kitchen, which is open to the public for inspection. Here you can see the kitchen electrical appliances in actual operation, besides the manner in which things are prepared for the cafe. For the amusement of the patrons a cabaret and orchestra are arranged for in connection with the cafe.

PHANTOM CIRCUIT

Most of us have used the telephone to a more or less degree, but few of us have been one of a party of six to talk over four wires. Six people talking at the same time would ordinarily require six wires to complete the three circuits. But by means of the Phantom Circuit, it is actually possible for us to make three circuits over four wires without interference. This is actually done in practice. People in Chicago can and do talk to people in New York by the use of this system. The exhibit showing the practical operation of this principle of telephony will be in the south-east lecture room in the Electrical Engineering building. There will be a pole line running from one end of the room to the other showing all wires used in transmitting the sounds. To make this as real as possible this line will be along a good gravel road with trees and shrubs growing along all sides. At either end will be three telephones all of which the public are requested to use in order to see for themselves that six pople can talk over four wires. The exhibit will be under the direction of Rossett and Summers, two of our E. E. Seniors, who are experienced in telephony. They will be found at the exhibit ready to answer questions and to make explanations as desired.

C. E. CLUB NOTES

The C. E. Club met for a short business meeting and election of officers on January 20. The officers elected for the second semester were:

R. J. Morrell, President.
A. K. Fogg, Vice-President.
J. H. Miller, Secretary.
H. S. Mahood, Treasurer.

The first meeting of the club under the management of the new officers was in the nature of a feed. All who attended pronounced it a great success. Besides the unusually good milk, doughnuts, and pies, the excellent program was a treat. Hale P. "Pee Wee" Byers, the Illini comedian, gave a number of musical selections. Prof. N. B. Garver followed with a talk upon a concrete arch bridge at Danville on which he will superintend construction. Prof. C. H. Woolbert of the Public Speaking department kept the audience in good humor with his wit and also gave some good advice.

P. W. Freark

W. S. Thomas, Treasurer of the Wagner Electric Manufacturing Company of St. Louis, has also been elected a Vice President of that company.

Walter Robbins, for many years Assistant General Manager of the Wagner Electric Manufacturing Company of St. Louis, has been elected a Vice President of that company.

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VOLUME XXIX MAY 1915 NUMBER 4

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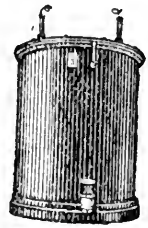

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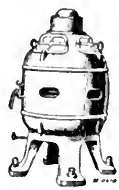

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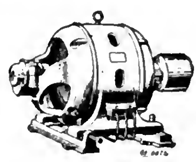

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The Technograph

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The Technograph

Vol. XXIX — May, 1915 — No. 4

THE NEW PROFESSOR OF CIVIL ENGINEERING

By I. O. BAKER

Mr. Frederick Haynes Newell, the new head of the Civil Engineering Department of the University of Illinois, entered upon his duties on May 1, in order to be fully prepared for active work at the beginning of the next college year. He comes from active professional work, having been for twenty-six years in government service, principally as Chief Engineer and later as Director of the U. S. Reclamation Service.

Mr. Newell is a native of what is known as the "oil country," having been born at Bradford, Pennsylvania, where his father, a New England engineer, was then engaged in the construction of a branch of the Erie Railroad. Educated in the vicinity of Boston, he graduated at the Massachusetts Institute of Technology in 1885 in mining engineering, and then took post graduate work in geology and hydraulics. Later he found employment in the oil regions of Ohio and in the coal areas of Virginia. He was designated as Assistant Hydraulic Engineer of the United States Geological Survey, on October 2, 1888, this being the date of the first appropriation by Congress of funds to investigate the extent to which the arid regions of the United States might be reclaimed. Starting thus as the first person appointed under this Act, Mr. Newell continued for over twenty-six years to devote his energies, not merely to the ascertaining of the physical conditions of the country, but also to the building up of a larger and better appreciation on the part of the public of the importance and magnitude of the problems of water supplies and of their conservation and use, thus aiding in the realization of the ideals which were embodied in the Reclamation Act.

This act, signed by President Roosevelt on June 17, 1902, set aside the proceeds from the disposal of public lands for survey, examination, construction and operation of irrigation works.

The bureau having charge of the expenditure of these funds—now amounting to over $80,000,000—was organized by or under Mr. Newell—as it was in effect an outgrowth of the investigations, started under the U. S. Geological Survey, and largely initiated and guided by him from the period of preliminary study to that of final completion.

The Reclamation Service under Mr. Newell's direction has constructed some of the largest dams and storage reservoirs in the world with systems of canals for distributing the stored water to about three million acres of agricultural lands. As part of the construction of the canals and reservoirs there have been built many miles of tunnels, also extensive controlling works, hydro-electric or steam power plans and hundreds of smaller structures such as head gates, bridges, flumes, and culverts; also scores of miles of wagon roads and of telephone and electric power lines, several short railroads, and almost innumerable buildings used for mills, offices, store-houses, or shelters for men and equipment. The work has been exceedingly varied in character and location, being at widely scattered points in seventeen western states. The engineering operations have thus embraced not only civil and hydraulic, but also hydro-electric, railway, mechanical, mining, structural, sanitary and other problems.

Growing steadily but rapidly from a single individual, the organization expanded until several hundred engineers, technical and clerical assistants have been employed, and a force of upwards of eight thousand laborers. The wide distribution of the work necessitated a quite elaborate and yet flexible organization, and the problems encountered have required the exercise of engineering and business judgment to a high degree. Frequently investigated by Congressional Committees and by special boards of engineers or experts the results have been commended both for economy and efficiency and no shadow of distrust has been cast upon them. The devotion of the members of the Service to the public welfare has been conspicuous and has attracted much favorable comment from foreign engineers and well informed citizens. Much of this has been due to Mr. Newell's personal influence and to his careful selection of men. His attitude has been to encourage and push forward the men of high character and initiative, laying out the work to be done, leaving to them the details and then standing behind each man,—protecting him as far as possible from red tape and petty annoyance, but demanding large results.

In addition to his regular work for the government and his service on various boards and commissions, Mr. Newell has given much time to various scientific and related organizations having been Secretary of the National Geographic Society and of the American Forestry Association, President of the Washington Society of Engineers, Vice President of the Cosmos Club of Washington, and a member of the American Institute of Mining Engineers, the American Society of Civil Engineers, etc. He is the author of many official reports, and of various pamphlets and books—some used as text books.

The broad experience had in discovering conditions, in initiating large work, in overcoming unusual difficulties, in attracting and holding men of high character and sharing with them an enthusiasm and a rare devotion to public service—lead to the hope that Mr. Newell in his new position may be of substantial aid in maintaining and forwarding the high ideals of Illinois.

THEODORE ROOSEVELT

THIRTY EAST FORTY-SECOND STREET

New York City, December 22nd, 1914.

My dear Mr. Breck:

For fourteen years I have followed at first hand the work of Mr. Frederick H. Newell, who until a fortnight ago was Director of the Reclamation Service. I speak from my personal knowledge when I say that he was one of the most loyal, disinterested and efficient public servants the United States had throughout that period.

I first came in touch with him when I was Governor, when I drew on him for aid and advice in formulating the proper conservation policy for the State of New York. During the eight years that I was President he was one of my right-hand men. It is too often the case in the United States that the men who are most prominent, who attract most attention, are inefficient or even vicious public servants, whereas the men who do the best work, work, I think, rather better than the work done by the public servants of any other nation, pass almost unnoticed and without any adequate reward. Mr. Newell belongs in that small group of invaluable public servants, of whom the most prominent representative is Colonel Goethals. Public attention has been attracted to Colonel Goethals, although it is extremely unlikely that he will ever get any material reward, such as his services, if rendered to a nation like England or Germany, would infallibly bring; but public attention has not been attracted to Mr. Newell; and the fact is a discredit to us as a people. He has rendered the kind of invaluable service that

Sir William Gosslin rendered to the British Empire in connection with the utilization of the waters of the Nile; and his work has been even more difficult.

It is most deeply to be regretted that our people as a whole do not in some efficient fashion show their appreciation of what he has done; and I very much regret it is in my power to do no more than pay this inadequate but sincere and heartfelt tribute to him. He is a public servant of whom it is the bald and literal truth to say, that by his services he has made all good American citizens his debtors.

Very sincerely yours,
THEODORE ROOSEVELT.

EDWARD BRECK, ESQ.,
Navy League of the United States,
Southern Building,
Washington, D. C.

BIOGRAPHICAL SKETCH OF IRA O. BAKER,

B.S., C.E., Dr. Eng'g.

Ira Osborn Baker was born at Linton, Indiana, Sept. 23, 1853, prepared in High School at Mattoon, Illinois. Graduated with the class of 1874 in civil engineering at the University of Illinois. At graduation he was appointed assistant in civil engineering and physics in the University of Illinois. Dr. Baker was instructor in civil engineering and later was promoted to Assistant Professor of Civil Engineering. He was appointed Professor of Civil Engineering in 1880, and has held that position continuously since that time.

During the early days, Professor Baker at various times taught many subjects, including general engineering drawing, surveying, railroad engineering, economical location of railways, civil engineering, astronomy, tunneling, contracts and specifications, and roads and pavements. He gave the course in analytical mechanics to students in all engineering courses. His teaching of physics and descriptive astronomy created delight and enthusiasm among general students as well as the engineer.

But the work of the engineering professor is not all done at home. Outside of the University, in the engineering societies, and among engineers and business men, Professor has carried the name of the University of Illinois. He has been a member of the American Society of Civil Engineers since 1893, and has twice been elected on its nominating committee, once traveling to the City of Mexico in order that he might be present at the meeting of this important committee and carry out the trust imposed in him. He has been a member of he Western Society of Engineers since 1886, and has twice been elected to office. One of the societies in whose membership Professor Baker takes pride is the Illinois Society of Engineers, a society which was conceived and founded by him in 1886, and which has had a very active and useful part in the development of engineering throughout the state.

Another society is indebted to Professor Baker for its formation. When the Engineering Congress of the World's Columbian Exposition was first considered, Professor Baker suggested and urged by forcible argument that a division of engineering education be included in it. He was made chairman of the committee which had charge of the division, secured papers and speakers for the very successful program, and organized the convention and presided at the meetings of the division. The proceedings of these meetings were printed as Vol. 1 of the Proceedings of the Society for the Promotion of Engineering Education, and Professor Baker is properly called the founder of this influential society. He has a considerable part in its further development and was again its president in 1899-1900.

A statement of Professor Baker's career would not be complete without mention of his writings. He was an early contributor to the Engineering News. To his early classes he issued text books on engineering instruments, railroad engineering, geodesy, etc. The author wrote out the many pages of these works long hand on tracing paper, and the books were issued in blue-print form at a time when the process of blue-printing was a novel one. The first text book issued in printed form was the Engineers' Surveying Instruments. The book which attracted the attention of the whole engineering world and made a national reputation for the author was his Masonry Construction, which was first published in 1899. The reception of the book was instantaneous. The Engineering Record said: "A work likely to be a standard in its line for a long time to come." Building said: "If you wish the best book ever published in the English language on masonry construction, turn with confidence to this treatise." London Building said: "Professor Baker's is unquestionably the most complete and most useful work which has ever yet been published in the English language on masonry construction." The book was introduced into the principal engineering schools of the country and has held its place to this day. It is used in the technical schools of Japan, China, Mexico, and other countries. Another book which has met a favorable reception is Baker's Roads and Pavements. One review says: "The author's clear, concise, logical presentation has made it a delight alike to the instructor, the student, and the practicing engineer." In addition to his text books, Professor Baker has found time to write a large number of articles which have been published in engineering and educational journals and in the proceedings of engineering societies.

A feature which should not be forgotten is the establishment of the Cement Testing Laboratory and the Road Materials Laboratory of the Department of Civil Engineering, which were pioneer laboratories in these lines, and have served as models for many colleges of this country. Professor Baker was an early investigator in brick, cement, and concrete, and he has made notable contributions to our knowledge of these materials.

Professor Baker has, through his forty years of service, been loyal to the interests of his alma mater, declining more than once offers which were tempting from more than one viewpoint, and the University of Illinois owes him a debt of gratitude for the allegiance which he, as an alumnus, has given.

Professor Baker was given the master's degree of Civil Engineering in 1878, and in 1903 the University of Illinois conferred the honorary degree of Doctor of Engineering.

SOME THINGS ABOUT CERAMICS
THE CERAMIC ENGINEER AND HIS WORK

By R. T. STULL

Ceramics as a science is so comparatively new that few people have more than a vague idea of what it embraces. When one mentions "Ceramics," he is often corrected in his supposedly bad pronunciation something like this: "Keramics? O, yes; clay modeling and china painting must be very interesting."

The words "keramics" and "ceramics" both originated from the Greek "Keramos," meaning a drinking cup made from a white clay called kaolin. Keramics has to do with the artistic side of clay working such as clay modelling, etching, china painting and the collection of rare pieces of "ceramic" art. The scope of ceramics is much broader. It not only includes keramics but also embraces the technical problems involved in the manufacture of abrasives, cement, lime, glass, enamelled iron and all kinds of clay products from common brick to the finest of art pottery.

There are between 9,000 and 10,000 plants classed under ceramic industries operating in the United States. The majority of these are comparatively small since a small portion of them employ more than 200 men. It is probable that not more than 1,000 of these plants could afford to employ more than one technically trained man. The ceramic engineer must, therefore, be a more or less "all around engineer."

The ceramic engineer is generally called upon to do a wide variety of things. A graduate in ceramic engineering, who entered the employ of a large brick company, has, in turn, performed the following duties with credit to himself and profit to his employers: served as kiln fireman, equipped a chemical laboratory and analyzed the different clays and shales used, surveyed and made a map of the company's property, built a tramway and trestle, built an addition to one of the company's plants, set machinery, designed a complicated roof truss, took charge of the repair force and reduced the repair cost by over 30%. At present he has complete charge of the burning in all three of the plants operated by the company.

Another case is that of a ceramic graduate who, after two years practical experience, took charge of a small plant making an enamelled product. His official title was that of superintendent. However he was required to serve in the capacities of factory foreman, head mechanic, chief draftsman, time keeper, shipping clerk, and chemist.

The training of the ceramic engineer must be a well balanced one between chemistry and engineering. In the portland cement, glass, pottery and enamel iron industries, his duties may be more of a chemical nature than of an engineering kind. On the other hand his duties may be more of the engineering kind than of the chemical in those industries manufacturing structural materials such as brick, sewer pipe and fire proofing. Even in these industries the engineer cannot get away from the chemical problems involved. He must understand the physical and chemical properties of clays and other ceramic materials and the changes they undergo in burning, the properties of fuels, and the principles of combustion. He must understand the relation between composition and the physical properties of ceramic products, the causes of defects and their remedies, and must acquire a number of other things which are not printed in books and which can only be learned by practical experience.

Some of the problems of an engineering nature involved in the ceramic industries are, the mining or "winning" of clays and other raw materials, their transportation to the factory, the mechanical problems of mixing, grinding, screening, tempering and molding of the wares, drying problems, the designing of dryers kilns and complete clay working plants. In order to equip the ceramic engineer with the knowledge he should possess so that he may be able to cope with the numerous problems with which he may be confronted, a course in ceramic engineering must necessarily be a broad one Four years of University training is none too long a time in which to acquire adequate training and the nature of the work is such that very little elective work is allowable.

There are five universities in this country offering technical ceramic courses. Of these, only two are giving courses which stand on a plane with other class A engineering courses. However, there are a great number of Keramic schools offering work of a purely artistic nature.

The field of ceramics is new and offers splendid opportunities for the engineer, and yet it is a field that could be easily overcrowded. In the ceramic field as in all other fields the supply of "top-notch" men has been far below the demand. It is the mediocre position for the mediocre man that is overcrowded.

No man is advised to choose ceramic engineering as a profession unless he takes great interest in that kind of work. He should be willing to work hard and not be afraid of getting his hands dirty, whether he wishes to follow teaching, research, or go into the industries. He should be ready to doff the cap and gown when he graduates and don the overalls when occasion demands, and to start at the bottom and work up. There are some big positions on top waiting for him, and in the climb he should remember that "push" outweighs "pull" in the long run

THE POSITION OF THE ENGINEER

(Abstract of Address given at the Sixth Annual Convention of Triangle, a Fraternity of Civil Engineers, by IRA OSBORNE BAKER, Doctor of Engineering, Professor of Civil Engineering, University of Illinois)

I was truly glad to accept the invitation of the committee to speak to you tonight, because of my interest in Triangle, and also because of a desire to say a helpful word to promising young civil engineers. For more than forty years I have been especially interested in engineering students and graduates; and I do not know where one could find a more promising group to whom he might bring a message of encouragement.

There are not lacking those who claim that the engineer does not occupy the position in his community to which he is entitled by virtue of the time given to his professional preparation or because of his intellectual ability. It is often claimed that engineering is a learned profession; but it is said that the engineer does not occupy as high a position among his fellows as does the lawyer, the doctor, or the preacher, members of the other learned professions. The usual requirements for admission to a collegiate engineering course, and also for graduation, are higher than is generally required for the lawyer or the doctor, and the engineer's education is usually more than that of some influential preachers; but nevertheless these professional men occupy a position of greater distinction in the community than does the engineer. It is seldom that an engineer takes a leading part in the discussion of questions relating to municipal franchises for street railroads or electric lighting, even though these are engineering matters; nor is it usual that the engineer has as prominent a position in the discussion of questions relating to city water supply or sewage disposal as the physician, even though these matters are in the field of the engineer. Again, the engineer is not as prominent in the discussion of moral and civic questions as is the preacher, although the engineer ought to be interested in public questions.

Again, who make the laws for the city or the state? I think you will all agree that the engineers are not represented in such work in proportion to either their numbers or their intellectual ability. If time permitted, it would not be difficult to show that in many cases state legislation has been unfortunate in that it has not been guided by sound engineering wisdom. It will be sufficient to cite one or two examples. In the cities of Illinois the law permits the owners of abutting property to decide upon the kind of paving material to be used in the adjoining streets, but makes the city responsible for the maintenance and renewal of the pavement;; and consequently the property owners, at least frequently, select the pavement of least first cost regardless of the efficiency and ultimate economy of the pavement. Numerous more glaring errors could be cited in several states concerning highway legislation; and similar examples could be cited in municipal ordinances concerning public utilities and public improvements.

It is also claimed that the engineer does not rise to the higher administrative positions as often as his training and experience would warrant, or as often as his professional services are really required. In how many states are there engineers on the railway commissions or in the public utilities commissions? Not many railway engineers rise to the higher administrative positions, at least not in proportion to their own numbers and to the number of such positions.

Of course, there are noted individual exceptions to the claim that the engineer does not receive his proportion of the higher administrative positions, and there are also noted examples of engineers' organizations rendering valuable aid in public affairs; but nevertheless I think the views I have stated are substantially correct for the representative engineer and engineering organization.

The public realizes reasonably well the need of an engineer in certain lines; but usually regards him as being well versed in technical matters only, and does not regard him as a man whose opinion has weight in non-technical matters. Too often he is simply a tool of others.

It is worth while then to inquire why the engineer does not have a more prominent position among his neighbors, and why he does not more often rise to the higher administrative positions.

In the first place, this lack of influence is not because of lack of education, for the usual requirements for admission and graduation for engineers are at least equal to those ordinarily required for lawyers and doctors. Further, that the engineer does not occupy these positions, is not because of lack of need of his services, for many of the public positions demand the qualities of mind and the experience possessed in a large degree by engineers. Again, it is not because of lack of intellectual ability that engineers are not influential in their community.

The failure of engineers to acquire a position worthy of their professional training and intellectual ability is partly because many of them work in isolation. For example, an engineer may spend two or three years in an uninhabited region in constructing a water-power development or in driving a tunnel through the mountains, and thus be deprived of the opportunities to mingle with his fellows or to participate in public affairs.

But I am persuaded that the chief reason why the engineer does not attain to the position in the public estimation which he might occupy is because of wrong ideals. The representative engineer magnifies the importance of technical matters. In college he is insistent upon acquiring a so-called practical education, that is he desires to specialize and to take only the subjects immediately connected with his chosen profession. As a consequence, he lacks breadth of view and is weak in knowledge of non-professional matters. Too often he has sought to perfect himself in technical details to the neglect of a knowledge of political procedure, of business methods, of labor conditions, or of social problems. Further, he is often seriously deficient in the ability to use correct and forceful language.

What then can the engineer do to improve his position in society, or rather what can you do, my young friends, to prepare yourselves for a wider usefulness and a larger success? I have several definite suggestions:

1. Conserve your health, be strictly honest, and keep your heart pure. Considering my audience, I need not say any more on these matters.

2. By continual care and practice, cultivate the ability to express yourself in writing and in oral speech in clear, concise, correct English. There is nothing more necessary to the young engineer who desires to attain more than a mediocre success.

3. Extend your horizon by reading and study of industrial and political history, political and social science, economics, labor problems, principles of banking, rate regulation, and other vital subjects that will suggest themselves. There are numerous volumes on any of these subjects that are intensely interesting and instructive.

Reading along these lines will be of inestimable value in widening your horizon and in increasing your knowledge; but such study may also easily be made of greater importance as intellectual training. Thus far you have devoted nearly all of your time to the study of absolute truth. The facts have been placed before you, and you have been expected to acquire a comprehension of the principles and to apply them to stated examples. Heretofore you have been dealing with the science of necessary conclusions; but hereafter you will deal with problems to which you can find only probable answers. In many of the problems with which you must deal in the future, the principles to be employed will not be stated, and it will be necessary for you to discover the fundamental relations for yourself. Further, you will find that there is conflict between some of the factors, and you will be called upon to discriminate as to the weight to be given to the various elements of the problem. This will require accurate observation, close analysis, and careful judgment. A study of the subjects I mentioned will afford you stimulating intellectual exercise along new lines. Many problems arise in practical life in which the principles involved are not stated with anything like the clearness of the problems that you have confronted thus far. In a sense your training has unfitted you for the solution of these newer problems, since you have not usually been accustomed to discover the fundamental principles, nor to weigh the factors, nor to harmonize discordant elements. I am sorry that I can not take time to discuss this point more fully.

4. Be careful in selecting your associates. A leading American civil engineer who was just getting started in his professional career once said that he could not afford to go to the annual convention of the American Society of Civil Engineers because he wanted to join a certain club, the leading club in the city in which he lived, for which the entrance dues were $600. He said that he wanted to make the acquaintance of the men in that club, for they virtually controlled the commercial affairs of that metropolis. Do not misunderstand me. This man did not entirely neglect technical societies, but he did join the club referred to, and now he has an annual salary of $50,000, and gets some large fees besides. The initiation fee to the club was not wasted; and his success was not simply luck. I am glad to know that two promising young civil engineering friends of mine have recently joined that same club.

5. There is a radical change that comes when a man leaves college, which many graduates fail to understand. Before graduation, the chief object of those who have affected your life most, your parents, your teachers, your friends, has been to serve you; and your sole purpose hase been to receive. But after graduation, the chief object of your life must be to serve others. Before graduation your chief ambition was to know, but after graduation your chief duty will be to do. The change of attitude from being continually expected to receive, to one in which you are expected to give, is very great; and not unlikely will cause you to make some unconscious mistakes. For example, if a few weeks or months after graduation your work has ceased to be instructive, you may not ask your employer to change it solely to enable you to secure more valuable experience, for it is your duty to put his interests above your own. Young graduates fre-

quently fail to appreciate the difference in relationship to them of the professor and the employer, and do not understand the difference between their own relationship to the college and to the company. Further, the employer is likely to be more exacting as to attendance and promptness, and to demand more as to compliance with instructions than the college professor; and it is usually necessary that he should be more exacting. These matters may seem to be small, but a proper understanding of them is necessary for success if one works for others.

6. Do not become a man of technical details nor a man of books to the exclusion of a knowledge of affairs. In the first place, the successful engineer must buy materials; and therefore he must have a knowledge of market conditions and of business methods. These come only by close observation. Notice that I do not say they come by experience. Of course, they come through experience; but experience alone does not give the necessary knowledge. They come only through thoughtful observation and careful analysis. In the second place, a successful engineer directs the labors of others; and therefore he must know much of the motives that influence men, and must understand the point of view of organized labor, and should have at least some knowledge of the advantages and disadvantages of the different methods of payment. In the third place, an engineer is frequently called upon to report upon projects; and therefore he should be able to foresee all the industrial, commercial, and financial conditions involved in the project, and should be able to accurately discriminate as to the relative importance of the various conflicting factors. In the fourth place, the engineer writes specifications and makes contracts and therefore he should know something of the intricacies of the law. In short, the successful engineer must have technical knowledge, but he must also be a man of affairs, knowing men and business methods.

7. Participate in public affairs, not only to discharge your political and social duties, but also because of the development and breadth of view that will come to you.

I was pleased to hear incidentally this afternoon that the civil engineering students of Purdue University held a proportionally large number of the college political offices, which is instructive as showing their interest in public affairs, and also their ability for leadership.

8. Finally, be courageous, have an ambition for a large success and then work hard to attain that goal. May abundant success crown your efforts, and real joy attend you through a long and useful life.

Transportation Building
Headquarters, Illinois Miners' and Mechanics' Institutes

SHORT COURSE IN COAL MINING

By R. Y. WILLIAMS

Through a cooperation with the Department of Mining Engineering at the University of Illinois, the Illinois Miners' and Mechanics' Institutes will offer a short course in coal mining at Urbana beginning June 7 and continuing until July 17, 1915.

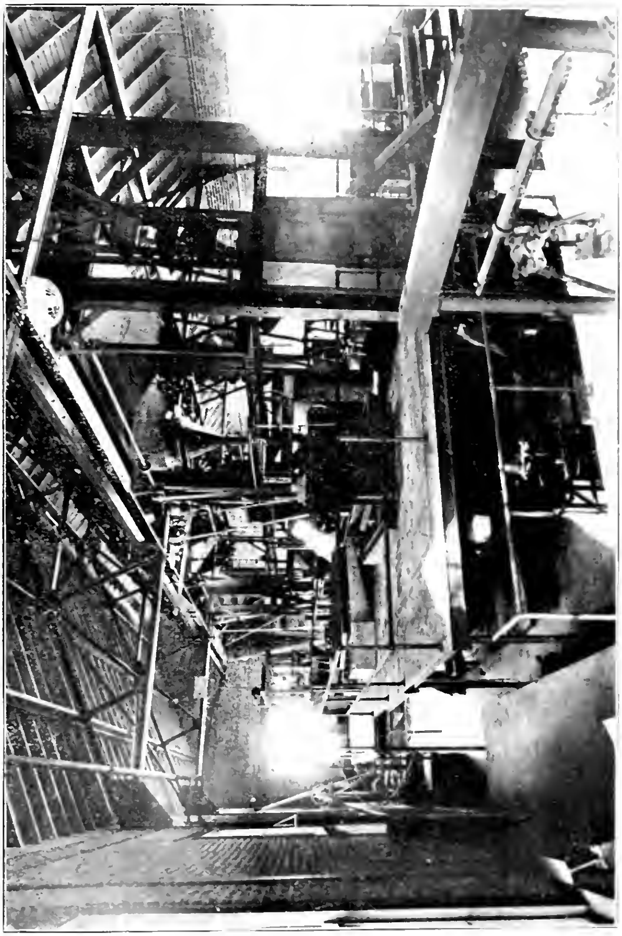
This short course should appeal strongly to men who desire to apply to the State Mining Board for certification to the positions of state mine inspector, mine manager, mine examiner and hoisting engineer, because it will permit them to review their technical knowledge of the development and operation of coal mines. Men who attended the short course in 1914 were successful in passing the State examinations for mine manager and examiner.

The course should be attractive, also, to superintendents, certified men, and others who wish to keep abreast of the times. The science of coal mining is developing rapidly, and no better opportunity for the exchange of ideas on mining can be offered for the busy men about the mines than the short course at the University.

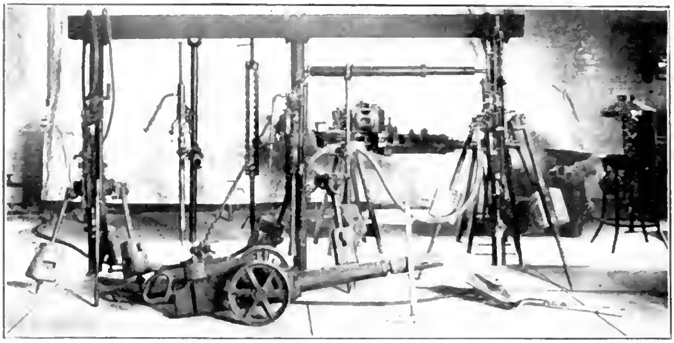
When work is slack, as it has been recently in some of the camps, the men who are interested in getting ahead should fit themselves to be in demand during this dull time and to be ready for rapid promotion when times are again prosperous. It is better for a man to take a six weeks' short course than to remain at home and be dissatisfied with local conditions.

The same subjects will be studied during the short course as are taken up in the regular schedule of the two-year course, and the practical aspects of these topics will be treated in the same manner as in the longer course. Because the men spend full time on this work the progress will be very rapid; and because of the completeness of the University laboratories and equipment a great deal of ground can be covered in the short six weeks' period.

For the benefit of those who cannot remain for the full six weeks' course, each applicant may register for the particular subjects in which he is especially interested and may receive credit for the work accomplished. In this way, a man who can spend only two weeks at Urbana will be able to receive technical training in those subjects which appeal to him most strongly, and he will be able to come into close touch with the Miners' and Mechanics' Institutes and the University of Illinois, in both of which he has a certain proprietorship.



THE COAL WASHING AND ORE DRESSING LABORATORY
This Laboratory occupies a space 42 feet by 50 feet



DRILLING LABORATORY

A block of concrete sunk in the floor is used for testing and demonstrating the use of drills and coal cutters, operated by electric or air power.

SAFETY LAMP AND COAL DUST LABORATORY

The safety lamp, mine gas and explosibility of dust laboratory contains an assortment of safety and electric mine lamps; magnetic-locking and lighting devices, and the most improved appliances for testing lamps. It also contains apparatus for gas analysis and a photometer room for determining the lighting power of mine lighting devices.

During the short course, four hours each morning will be spent in lectures and discussions which will be conducted by the teaching staff of the University and of the Institutes and by men actively engaged in mining operations. During three hours each afternoon, courses will be given in the mining laboratory, in the electrical laboratory, in the drafting room, in surveying on the campus, and in first aid work at the University Mine Rescue Station. Representatives of both the U. S. Bureau of Mines and the State Mine Rescue Commission will have charge of the first aid training, and it will thus be possible for men to receive both State and National certificates for proficiency in this subject.

In the conduct of the short course, a large amount of personal attention will be given to each student. Each man knows just what he hopes to obtain from the short course, and if he will let his wishes be known (preferably by letter to the Director before June 7th) everything possible will be done to fulfil those wishes. For example, if several men who have had first aid and drawing desire to pay special attention to surveying, they will be given an opportunity to spend every afternoon of four weeks in surveying on the campus with the assistance of an instructor. The same kind of personal help is given in arithmetic, so that each man may proceed as rapidly as he is able. Any man, who may feel that he is specially weak in arithmetic, may report at Urbana on May 30th for a complete week's work on that important subject before the opening of the short course.

Several informal evening meetings will be held to discuss certain mining subjects of general interest, such as "Mine sanitation," "Comparison of mining laws in different states," "Welfare work among industrial workers," "Coal fields outside of Illinois," etc.

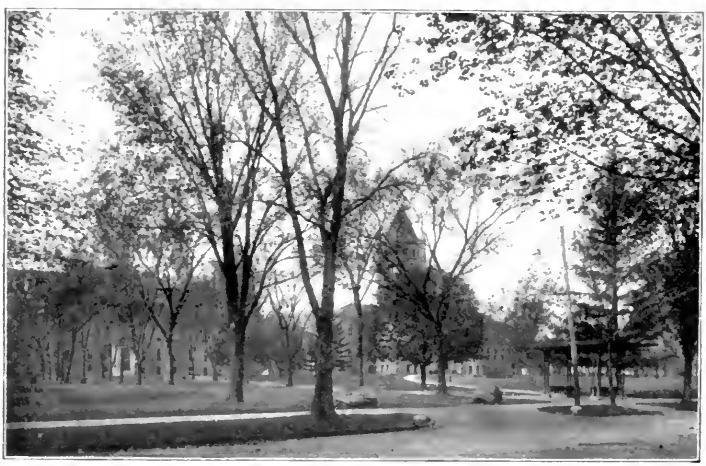
On Saturday afternoons, field parties will be organized to visit places which are of interest from a geological point of view, these trips to be given with the assistance of the State Geological Survey. Also, excursions will be taken to the Danville coal fields where extensive stripping is being carried on hydraulically and by means of steam shovels.

A number of University attractions will be open to men enrolled in the short course. The first ten days of the course will be held during the commencement period, and ball games, band concerts, and other college functions are interesting to everybody. The last four weeks of the course will extend over the greater part of the summer session, at which many excellent lectures, plays, etc., are held for the entertainment of any who desire to attend. The swimming pool, tennis courts, bowling alleys, etc., are open to short course students under the same terms as to regular University students.

The total cost for the complete six weeks' course should be less than $50.00 for each man who attends. There is no charge for enrollment or tuition, and no text books are required other than those furnished free by the Institutes. In addition to the railroad fare, each man will have to pay $5.00 to $6.00 per week for board and lodging which he may secure near the Transportation Building where the courses will be held.

SHORT COURSE IN COAL MINING
1915
UNIVERSITY OF ILLINOIS, URBANA

Date	Time a. m.	Morning Sessions	Afternoon Sessions
June 7 – 12	8	Mathematics	
	9	Geology	Mining Laboratory
	10	Electricity	Electricity Laboratory
	11	Coal, a Fuel	
June 14 – 19	8	Mathematics	
	9	Surface Plant	Mining Laboratory
	10	Electricity	Electricity Laboratory
	11	Methods of Mining	
June 21 – 26	8	Mathematics	
	9	Steam	Safety lamp Laboratory
	10	Haulage	Drawing
	11	Methods of Mining	
June 28 – July 3	8	Mathematics	
	9	Mine Gases	Safety lamp Laboratory
	10	Ventilation	Drawing
	11	Hoisting	
July 5 – 10	8	Mathematics	
	9	Surveying	Surveying on the Campus
	10	Ventilation	First Aid
	11	Drainage	
July 12 – 17	8	Mathematics	
	9	Surveying	Surveying on the Campus
	10	Explosives	First Aid
	11	Fire Protection	



A TYPICAL VIEW ON THE UNIVERSITY CAMPUS

THE SUMMER MILITARY CAMP

By R. J. SUTHERLAND

The University of Illinois promises to assume a prominent rôle in the National Reserve Corps Movement for the Military Instruction Camp at Ludington, Michigan, the coming summer. Already thirty-five students have applied for admission to the Ludington Camp, and indications are that by the end of school a delegation of fifty Illinois students will be organized to attend the camp, which will be held from July 5th to August 8th.

Each student will be credited with two hours standing toward the military requirements of the University, for attendance at a summer camp. Also, preference will be given, in the selection of officers, to those men who have attended the camp.

The coming summer will mark the second camp at Ludington. The movement, though new, is growing rapidly. Last summer, of the 112 men in attendance at the Ludington camp, the 16 students from the University of Illinois was the largest delegation, consisting of more men than any two of the 56 colleges represented. It is expected that the total enrollment for this summer will reach the 350 mark, and with its prospective delegation of fifty students, the U. of I. hopes to uphold its reputation of last year.

SITUATION OF THE CAMP

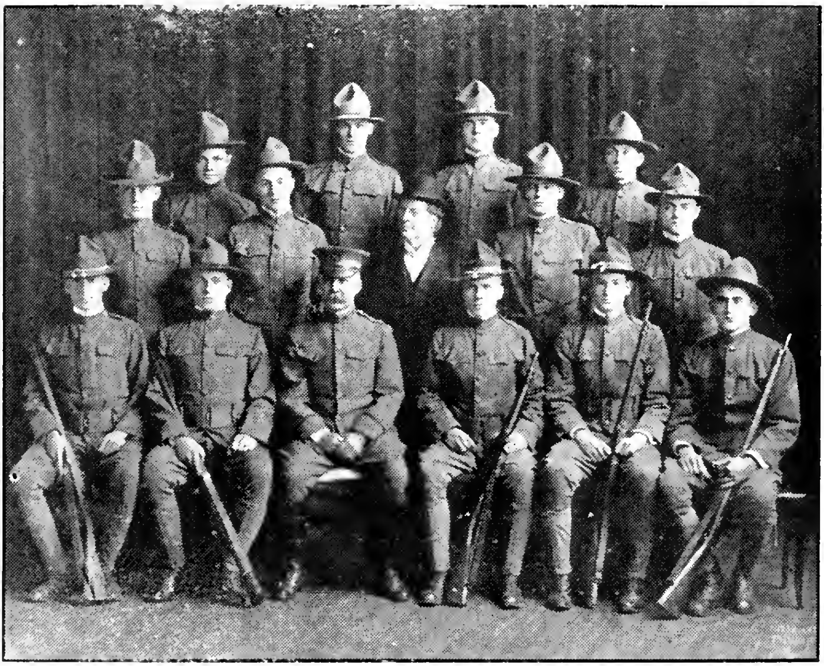
The camp near Ludington has proven to be a popular spot for the camp, as evidenced by the unanimous vote of the members of last year's corps to re-establish at the same place this year. Situated in the heart of the summer resort district on the east shore of Lake Michigan, and being only a mile from the city of Ludington, it provides an ideal spot for a summer outing.

PURPOSE OF THE CAMP

The purpose of the summer camp movement is to give young men an opportunity for military training, and to fit them for military duty in case of need. The benefit of the camp to the nation will come from a quickening in the patriotic spirit and a more widespread knowledge of military policy and needs. The men who have spent a summer at the camp heartily indorse the movement, as is evidenced by the application of over half of last summer's camp for admission again this summer. They not only realize the opportunity for military training, but find the life of the camp ideal for a good time during the summer vacation.

EXPENSES

In order to accommodate as large a number of students as possible, the government pays the greater part of the expenses of the camp. Students are required only to pay their transportation and a nominal fee of $17.50 for board while at the camp. In addition, however, students must provide themselves with the olive drab uniforms which are to be used in the Military Department of the University of Illinois next year. Applications for admission this summer may be sent to The Adjutant General,



Central Department, U. S. Army, 5th floor of the Federal Building, Chicago.

The mornings, except on Sundays, were wholly devoted to camp duties and military work. For the afternoons, however, there were no prescribed duties except required attendance at occasional lectures. Such afternoon work as there was—and there was considerable—was in general voluntary on the part of the students and in the nature of recreation. It included mainly riding and swimming; but for a part of the time gallery rifle practice and range shooting was conducted in the afternoons as well as during the mornings. The evenings always were left free to the students.

The camp gives the engineer a chance to practice his duties in warfare. The main duty of engineers is to apply engineering science to the emergencies of modern warfare in order to protect and assist troops, to ameliorate the conditions under which they serve, and to facilitate locomotion and communication. Tools and materials are their characteristic weapons, but when circumstances demand they are thrown into the combat as purely fighting units.

Of the Regular Army there was a company of infantry, a troop of cavalry, and a band present at the Ludington camp. The students were organized as a battalion of two companies, though they constituted but a single mess. Each company had a regular officer in command, but the subaltern officers and all the non-commissioned officers were drawn from the students themselves. Additional regular officers were on duty as student instructors and on the staff of the camp commander. The band, of course, added much to the enjoyment of all present. It is thought that the camp was of benefit mentally and physically to all fortunate enough to attend, whether belonging to the regulars or to the student body.

The Technograph

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THE TECHNOGRAPH, Champaign, Ill.

EDITORIAL

It is with mingled feelings that we witness the retirement of Professor I. O. Baker as head of the Civil Engineering Department; with regret because not only the department, but the University and students also feel the loss of such an eminent authority and teacher; with thanks and gladness that he was able and has faithfully served the University for so many years. The Technograph takes this opportunity to thank Professor Baker for his constant aid and advice to this magazine. We also want to welcome his successor, Professor Newell. Mr. Newell has a worthy predecessor but he has shown that he is entitled to be the head of the Civil Engineering Department of the greatest engineering college of the country.

E. E. SOCIETY NOTES

On April 8-9-10, the E. E. Society held one of the most successful Electrical shows ever given by any technical institution. All members of the Society worked together to make the many exhibits as complete as possible. Exhibits, varying from stunts made with a view to amuse, to the large instructive demonstrations of things new to the electrical world, were to be found in the various booths. The show was a decided success from both a financial and instructive standpoint. Over five thousand visitors attended the show during the three days.

On Friday, April 23, Mr. T. D. Yensen of the Engineering Experiment Station addressed the E. E. Society on the "Magnetic Properties of Iron and Iron Alloys". The talk was very interesting, due to the fact that Mr. Yensen has recently conducted some extensive research work on this subject in the laboratory, and showed some of the results of his work. A short business meeting was held after the regular meeting. D. G. Evans was elected the representative of the E. E. Society on the Technograph Board. H. L. Oleson was elected vice-president of the Society to fill the vacancy due to the withdrawal of R. V. Waller from the University.

At a joint meeting of the A. I. E. E. and E. E. Society, held Friday, April 30, Mr. I. W. Fisk of the E. E. Department gave a very instructive talk on Storage Batteries, their manufacture and varied uses. The talk was illustrated by lantern slides, showing some of the largest battery installations in the country, capable of delivering 25,000 amperes for an hour.

H. R. RICHARDSON.

M. E. SOCIETY NOTES

On March 25, 1915, a representative of the Link-Belt Company of Chicago, Illinois, gave an interesting illustrated lecture on conveyors and coal handling machinery. The meeting was well attended. The lecture was very instructive and gave a good idea of what can be accomplished by belt convenyors. At this meeting a committee for the M. E. smoker was appointed and set to work immediately to plan a smoker. This smoker turned out to be the best given in years.

On April 30, after several postponements, the smoker was given at the Y. M. C. A. The means of advertising were novel; the tags used, which were made in the shops, were made of aluminum and so cast as to make them serviceable as watch fobs. The programme was the best ever given at a smoker and consisted of good talks, music, and three reels of pictures. Prof. Newell, the new head of the C. E. Department, gave an interesting talk. The stories and eats were declared, by those present, to be the best ever given at such an occasion. The M. E. Smoker is an annual affair and is destined to become one of the most important M. E. activities.

R. E. WEINSHENKER.

C. E. SOCIETY

The C. E. Society was entertained on March 25th by a very interesting and instructive talk by A. K. Fogg on the "Wichita Terminal". Mr. Fogg illustrated his talk with photographs and blueprints.

On April 20th, the Society was honored by the presence of Dr. Newell, who has since been chosen to succeed Prof. I. O. Baker. Dr. Newell told in a most amusing manner his experiences as a field engineer and as head of the U. S. Reclamation Service. H. S. Mahood read a carefully prepared paper on the "Alaska Survey", which gave to his listeners a reliable knowledge of the conditions and difficulties to be overcome in this work. A lively open discussion on the "Status of the Engineer" followed, led by President Morrell. The consensus of opinion was that although in some cases the social and political status of the engineer could be raised, the engineer was in no sense a back number in either of these lines of endeavor. Prof. Baker ended the program with one of his straight-to-the-point talks.

C. B. TAYLOR.

RAILWAY CLUB

On February 26, Mr. E. G. Young, a post-graduate student in Railway Mechanical Engineering, gave a splendid talk before the Club on the subject, "Types of Locomotives". Mr. Young's talk was well presented and was illustrated with numerous lantern slides showing the various types of locomotives that have been and are being used in this and foreign countries.

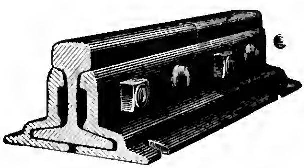
At the meeting of March 12, it was decided to hold a banquet before the end of the semester, and a committee composed of Rukin, Richers, and Clark was named to make the necessary arrangements. Mr. Pike was appointed to serve with the President on the Engineering Dance Committee, this committee being composed of the President and one representative from each of the various technical societies.

Mr. C. M. Clark, Railway Mechanical Engineering '17, has been named as a member of the Technograph Board, representing this Club.

C. M. CLARK.

The Wagner Electric Manufacturing Company of St. Louis announces the change in address of its Minneapolis Office, from 1040 Security Bank Building to 307 Security Building.

The Rail Joint Company



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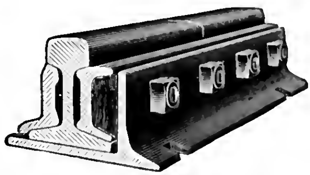

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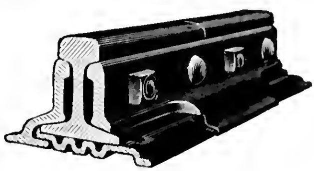

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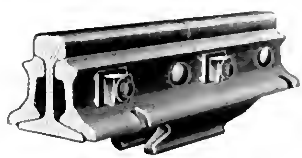

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